THE REFINER AND NATURAL GASOLINE MANUFACTURER

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Organization Keeps Natural Gasoline on Upgrade.
By Grady Triplett.

Refinery Methods for Blending Natural Gasoline.
By H. L. Kaufman.

Natural Gasoline—A Natural Resource.
By John M. Hall.

Standardization Sought in California Gasoline Corporation Plants.
By George H. Reed.

Centralization Contributes to Indian Refining Company's Success.
By Keith L. Evangelist.

Vol. 5 No. 5 MAY, 1926 $1.00 Per Year

HUGHES

LABORATORY SERVICE

The Quality of Hughes Products reflects the exacting supervision of materials and processes maintained by the Hughes Laboratory organization.

For many years Hughes customers have benefitted indirectly from this service.

We are now prepared to undertake a more direct service in the investigation of materials used in the Producing and Refining Industry.

Complete equipment for physical and chemical analysis available.

Hughes Tool Company

Main Office and Plant
Houston, Texas

Branch Plants:
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New York City, N. Y.

A SYMBOL *and its* IMPORT

. . This Mark is a symbol of correct engineering theory based upon specialized engineering knowledge; of proper materials fabricated in a highly developed factory; and of efficient performance under specified conditions.

C. F. BRAUN & CO.
Manufacturing Mechanical Engineers
Tulsa Alhambra, Calif. Dallas

BRAUN

FLUID HEATERS . . . . . COOLERS . . . . . HEAT EXCHANGERS
GASOLINE PLANTS . . . REFINERY APPARATUS . . . POWER PLANT EQUIPMENT

Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the Act of March 3, 1879

Fifteen million dollars in stock and equipment, it is estimated, were lost in two California tank fires during the week of April 4th-11th, 1926.
Los Angeles Times photo.

FIRE STRIKES QUICKLY! A few hours may wipe out huge accumulations of capital.

This particular danger in the petroleum industry is emphasized by the speed at which a fire may spread, once it has gained a foothold.

The intense heat that is radiated from a burning tank or reservoir will often boil the oil in adjacent tanks that are uninsulated. An explosion usually results and, as in the case of the recent fires at La Brea, California, and San Luis Obispo, California, the losses run into staggering millions.

When storage tanks and the tops of reservoirs are protected by an insulating covering, fires are much more easily kept from spreading. It is very important, of course, that the insulation used be of non-combustible material, or it may help to spread fire instead of retard it.

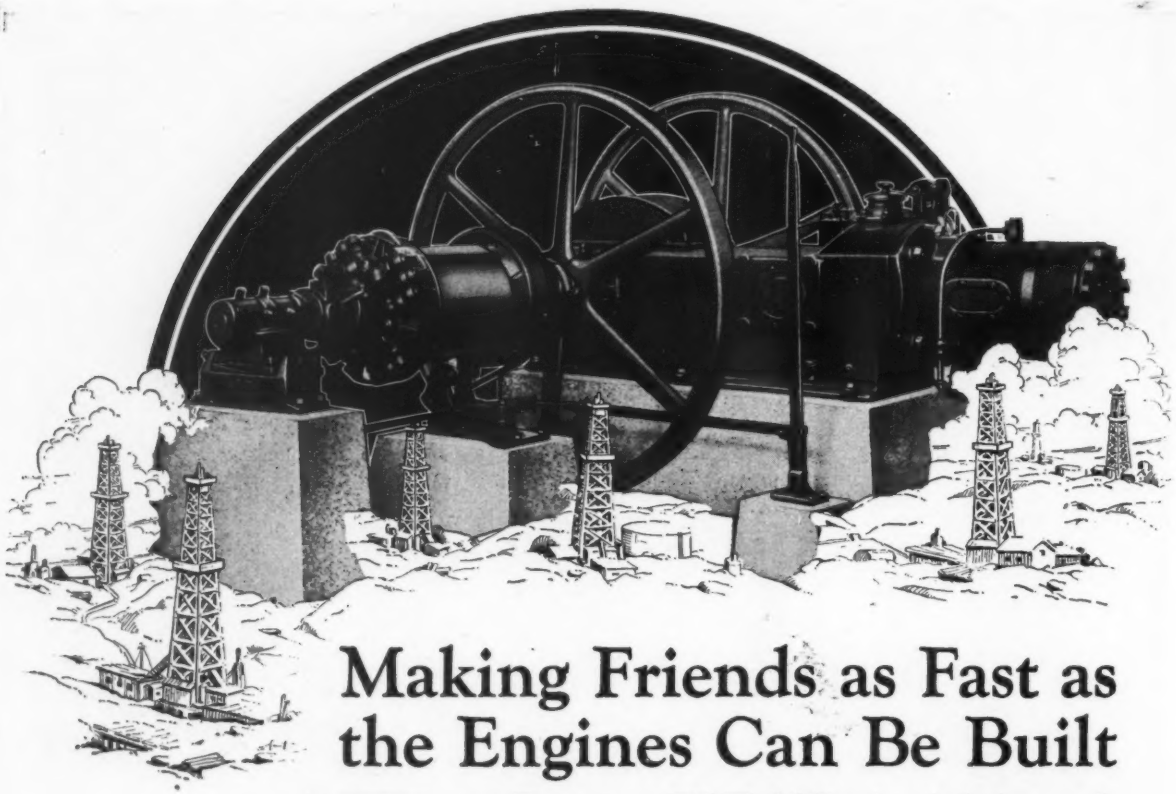
SIL-O-CEL Insulation Isolates Storage Tanks

A thin veneer of Sil-O-Cel insulation forms an effective barrier against heat penetration. One and one-half inches, ordinarily, are used on storage tanks and on the roofs of reservoirs.

The cost of the material, plus the expense of its application, is readily repaid through the reduction of evaporation losses which it effects. Its maintenance is negligible, for Sil-O-Cel never deteriorates or loses its insulating value.

Let us send you all the facts, tersely presented in our Bulletin C-19 on the insulation of Oil Storage Tanks. Address: Celite Products Company, 11 Broadway, New York, or 53 West Jackson Blvd., Chicago, or 140 Spear Street, San Francisco.

SIL-O-CEL
HEAT INSULATION



Making Friends as Fast as the Engines Can Be Built

THE new Bessemer Oil Field Engine is being welcomed everywhere! It's making friends as rapidly as we can make the engines—but it's an engine that can't help being popular. THIS NEW BESSEMER IS THE GREATEST STRIDE IN OIL FIELD ENGINE DESIGN IN THE LAST DECADE—an engine for hard oil country service that has all the features of the finest commercial gas engine.

Typical Bessemer construction assures rugged serviceability. It will stand up under the hardest kind of usage. It is simple, yet includes more improved features than any other engine. It is an Oil Field Engine de luxe that only Bessemer's huge plant facilities can make possible at such a low cost.

Here are a few of the construction features.

Entirely Enclosed.
Combination force feed and splash lubrication.
Air valve on top of bed plate.
Entire front of cylinder head removable.
Removable plates on either side of cylinder permit quick, easy access to water jacket space.
Larger exhaust (6 in. on 30 and 35 H. P. sizes).
Outside bolting of cylinder to bed plate.
Bored crosshead with adjustable shoes.
Crankshaft perfectly balanced with counterweights.
Adjustable and removable main bearings.

Send for the specifications and construction details of the new Bessemer Oil Field Engine. You will be quickly convinced that it is far and away the finest of all oil field engines.

THE BESSEMER GAS ENGINE COMPANY
18 York Street ∴ ∴ Grove City, Pa.

BESSEMER

BESSEMER OIL FIELD ENGINES – COMPRESSORS VACUUM PUMPS – ROLLER PUMPING POWERS

Are you securing The Maximum Revenue from your Natural Gasoline Plants?

THE USE of The Gasoline Stabilizer assures increased production and improved quality at very low cost to the producer.

The proper equipment for your individual plant is determined by our engineers — without cost to you. They also determine the approximate increased production which will result from the use of the Stabilizer.

The Carbide and Carbon Chemicals Corporation maintains a complete field organization—Sales, Engineering and Laboratory—in the Mid-Continent Field and upon the Pacific Coast. These representatives will gladly consult with you about the use of The Gasoline Stabilizer and the merits of stabilized gasoline.

Information about the satisfactory performance of the Stabilizers now in operation and the probable increased revenue from your particular gasoline plant will be promptly furnished.

CARBIDE AND CARBON CHEMICALS CORPORATION

General Offices

CARBIDE AND CARBON BUILDING
30 East 42d Street New York City

Mid-Continent Field
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Tulsa, Oklahoma

Pacific Coast
BALFOUR BUILDING
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For Every Need of the Industry

SMITHSTEEL Pressure Vessels can be built in any wall thickness, in any diameter and of any length; to withstand any specified pressures to meet all operating conditions.

The facilities of the huge Smith plant, equipped beyond comparison for heavy manufacture, insure prompt delivery from a single still to a train load.

Entirely new methods are used in their manufacture to obtain results worth investigating.

SMITHSTEEL

Mention Where You Saw the Advertisement

Actual photograph. Complete unit leaving Smith plant October 15, 1925

From Raw Steel to Finished Still— Only the Best Meets the Smith Standard

BACK of every Smithsteel Pressure Vessel is the unceasing care and inspection that guards every step of the manufacturing process. Special analysis steel is formed by exclusive Smith processes into Cracking Stills of unusual safety and high operating efficiency.

Due to the unlimited specifications to which Smithsteel Stills can be made, full advantage may be taken of the most efficient refining processes.

Evidence of Smithsteel Pressure Vessel efficiency is shown in the high production records they are now setting in the industry.

A consultation with Smith engineers will convince you of the superiority of Smithsteel Cracking Stills.

A. O. SMITH CORPORATION • *Milwaukee, Wisconsin*
TULSA • LOS ANGELES

CRACKING STILLS

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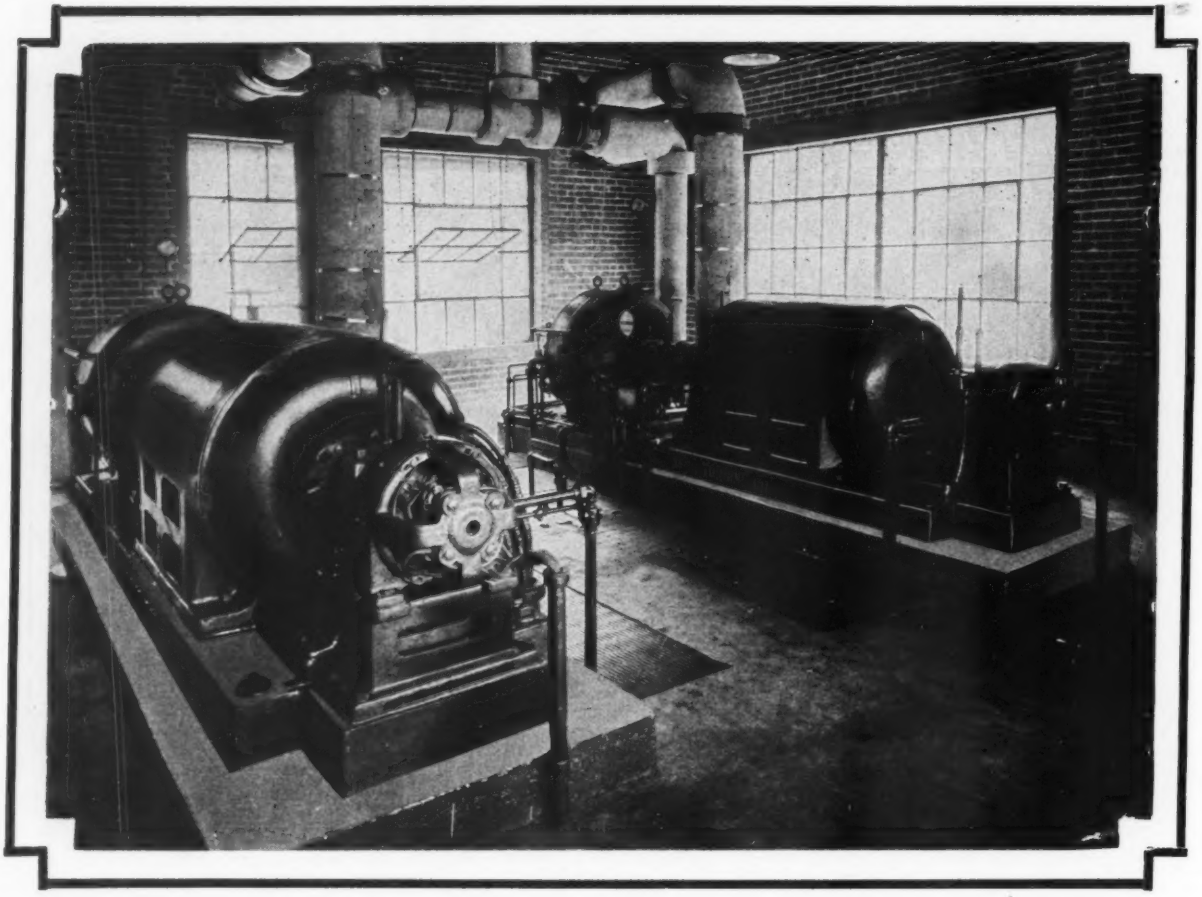

5% of total heat in steam produces power Balance utilized in process work

Many oil refineries are operating Kerr Non-Condensing Turbine-Generators for the purpose of skimming power from the steam during its expansion from boiler pressure to that required by the stills. The power so developed only absorbs 5% of the total heat, leaving the balance or 95% available for the stills.

The above illustration shows two 300-kw. Kerr Turbine-Generators operating in the plant of The Pennzoil Company at Rouseville, Pa. These turbines operate at 150 lbs. pressure, 100 deg. F. superheat and exhaust against 25 lbs. back pressure to oil stills. Less coal is being burned today than before installing the turbines, and a power bill of several thousand dollars per month has been eliminated and saved.

This is truly obtaining power as a by-product of the process stream and at practically no cost whatever. It is a system that can be widely applied to paper mill plants where low pressure steam is required for process work. Perhaps similar equipment could be employed to advantage in your plant. Let us discuss the possibilities with you.

Write for Catalog "H" describing Kerr High, Low and Mixed Pressure Turbines and Kerr Bleeder Turbines in capacities to 2500 kw.

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BLOW-OFF VALVES,
GREASE EXTRACTORS,
STRAINERS, SEPARATORS

H-463

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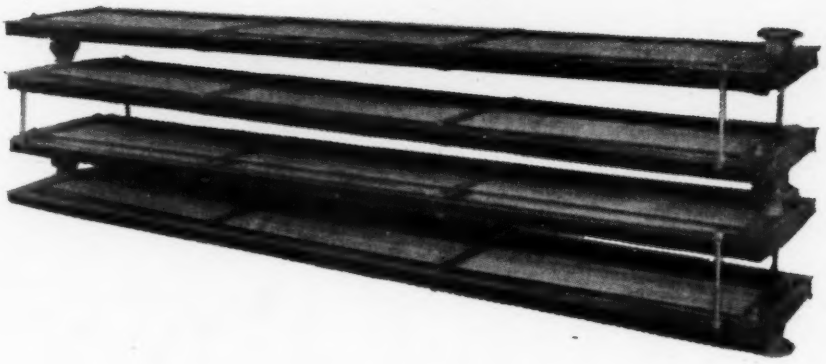
Won't Scale Up



The G-R Bentube Section

(Patented and Patents Pending)

is the greatest improvement ever made in atmospheric type coolers. It is automatically freed from scale by simply admitting steam to the bowed tubes, causing increase in flexure which cracks off the scale.

G-R Bentube Sections are standard and interchangeable, provide for expansion, drainage and easy cleaning, are easily moved to new locations, and can be added to as desired for increase in capacity or greater cooling effect.

Send the coupon for full information

The Griscom-Russell Co., Dept. K, 285 Madison Ave., New York

Philadelphia	Chicago	St. Louis	San Francisco
Rochester	Cleveland	New Orleans	Los Angeles
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Pittsburgh	Milwaukee	Dallas	Denver
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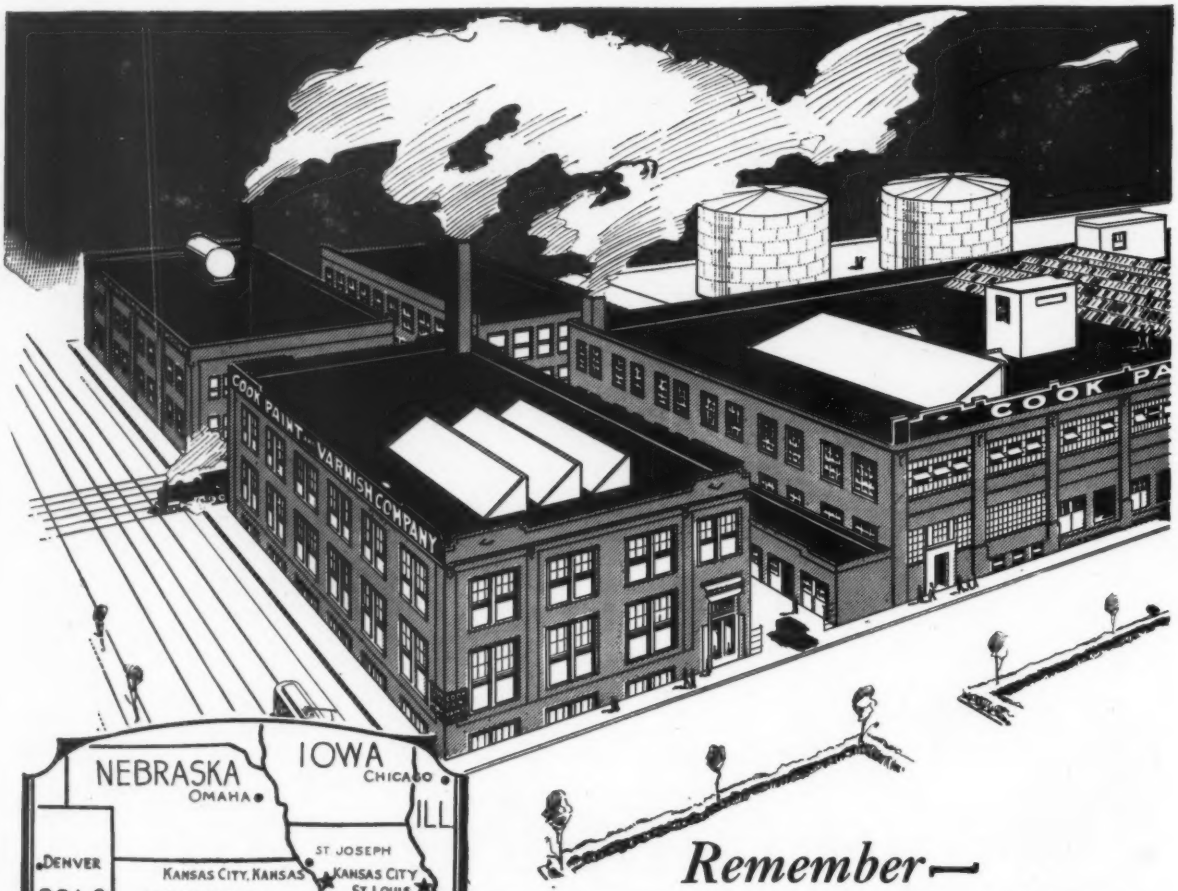
Griscom-Russell

Heat Transfer Apparatus

Name.....
Company.....
Address.....

THE GRISCOM-RUSSELL CO.,
Dept. K, 285 Madison Ave., New York
Send me at once without charge or obligation full information on the G-R Bentube Section.



Quick Service—*Located in the heart of the Mid-Continent Fields, Cook's have three factories and nine branch warehouses conveniently located to give you prompt service.*

Remember—

Cook *Pioneered* the Development of Specialized Paints for the Oil Industry

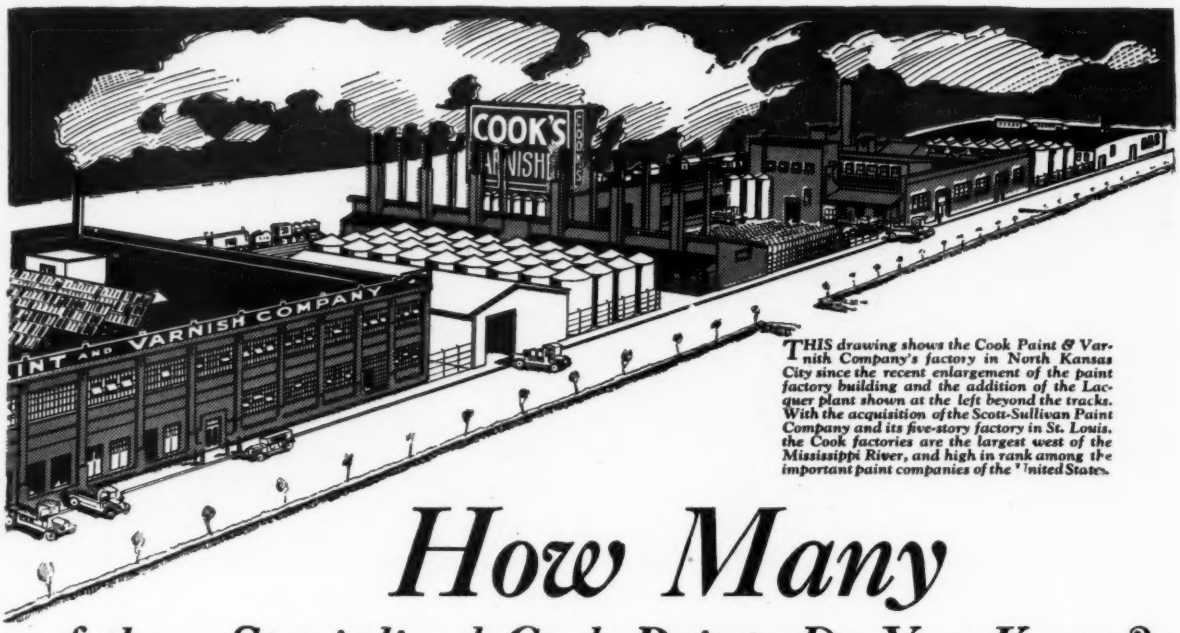
We can help you choose the *right* paint for each kind of painting job. *Specialized* paints are needed in the oil industry, in order to preserve steel refinery equipment, storage tanks, tank cars, tank wagons, etc.; and to cut evaporation losses. Ottentimes paint is subjected to the most adverse conditions—the most severe of which is atmosphere heavily laden with acid fumes.

The Physical and Chemical Laboratories of the Cook Paint and Varnish Company early recognized this problem. We know paint. We have spent a lifetime in the paint business. And being located in the very heart of the mid-continent oil fields, we have naturally specialized in the production of paints for the oil industry.

As specialists in this field, we have published an informative booklet on *"Specialized Paints for the Oil Industry."* It is packed with valuable information for anyone who buys paint; and we are glad to send copies free on request. Simply fill out and mail the coupon.

COOK PAINT & VARNISH COMPANY : : *Factories:* Kansas City—St. Louis—Fort Worth

Mention Where You Saw the Advertisement



THIS drawing shows the Cook Paint & Varnish Company's factory in North Kansas City since the recent enlargement of the paint factory building and the addition of the Lacquer plant shown at the left beyond the tracks. With the acquisition of the Scott-Sullivan Paint Company and its five-story factory in St. Louis, the Cook factories are the largest west of the Mississippi River, and high in rank among the important paint companies of the United States.

How Many

of these Specialized Cook Paints Do You Know?

To Restrain the Ravages of Rust—

When used as a metal primer, Cook's Rust Inhibitive Primer successfully resists rust caused by electrolysis and the presence of air and moisture, stimulated by acids and alkilis. It is brown in color; and is scientifically made from natural oxides of iron reinforced with highly basic lead and chrome pigments, ground in the correct proportions or treated oils. It is easily worked and dries under the most adverse conditions. It may be applied with either brush or spray; and is a most economical and serviceable paint.

To Beautify and Protect Your Tanks—

White paint is an effective agent for the prevention of evaporation losses in storage tanks, tank cars, etc. White and light shades of gray, etc., continue to be popular for general use and in these paints we offer practical and economical paint protection.

SHUR-WHITE Tank Paint has a satin-like texture which resists dirt and remains white even after years of service. It is economical enough for the largest surfaces. It may be applied with either brush or spray; and it covers solidly.

To Prevent Rusting, Pitting and Corrosion—

Steel-Kote should always be used where extreme protective qualities and durability are desired. The highly basic pigments and special heat-treated oils used in its manufacture insure a tough, elastic paint film that will prevent rusting, pitting and corrosion. Steel-Kote is economical and efficient because it is practical for either brush or spray application; it covers better and spreads farther than ordinary paints; it dries under all sorts of weather conditions; and it wears and wears and wears!

To Cut Your Evaporation Losses—

Color is of the utmost consideration in painting oil storage tanks. Scientists have proved that aluminum paint on a 55,000 barrel tank will save an evaporation loss of about 200 barrels annually over black tanks.

Cook perfected the new and unique "Ready-to-Mix" package, in which you may buy Aluminum Tank Paint that is sure to be *fresh*. Because it *is* fresh, it has greater "leafing power," it wears better, and it reflects light and heat most effectively. You mix it on the job as you use it. The Cook package assures easy and foolproof mixing.

Branches: Chicago—Omaha—Wichita—Oklahoma City—Tulsa—Dallas—Denver—Kansas City, Kansas—St. Joseph, Missouri

COOK PAINT & VARNISH CO., Dept. 1003, Kansas City, Mo.

Gentlemen: Please send me, without obligation on my part, your booklet on "Specialized Paints for the Oil Industry." We are

☐ Producers ☐ Refiners ☐ Marketers and are interested

in paint for (what purpose?)_____

*Name of Company*_____

*Individual To Address*_____ *Title*_____

*Address*_____

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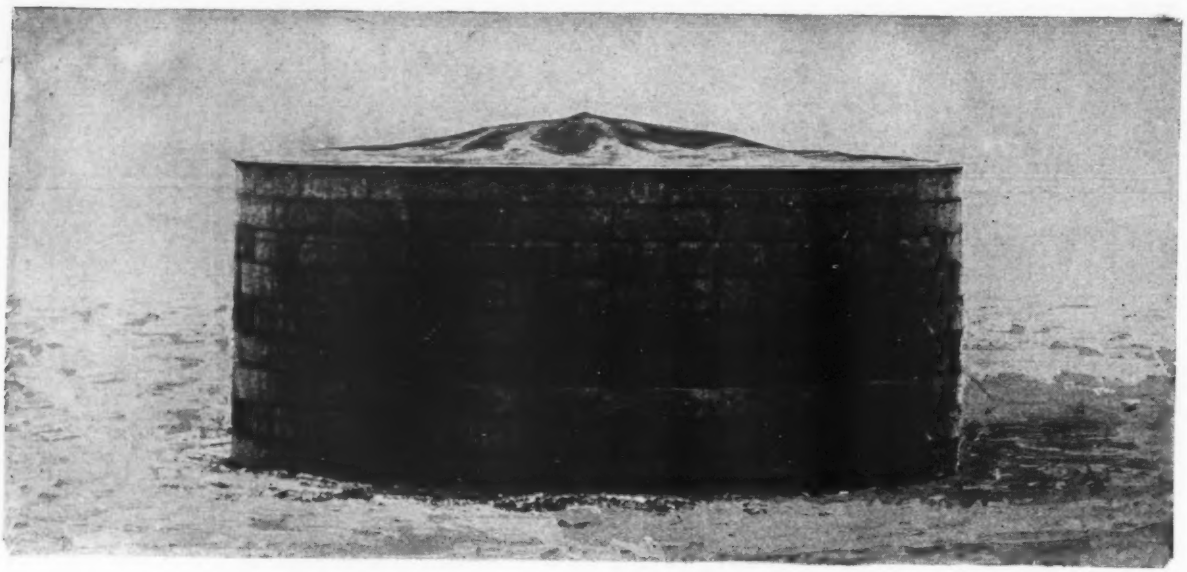
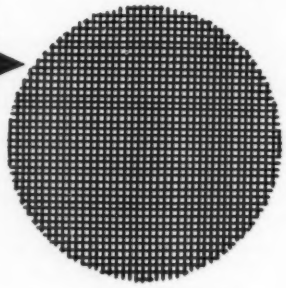


An 80,000-Barrel Tank Wrecked
by a Clogged Brass Screen



OCECO
FLAME ARRESTOR

8" Flame Arrestor with double flange vent collar and weather hood.

ARE your tanks protected by an approved flame arrestor, or merely screened?

Fine screens clog from corrosion, dirt and ice and *endanger the tanks.*

Your Investment in your tanks justifies a sure protection. With over 1000 Oceco Flame Arrestors in use no tight tank, thus properly equipped, has ever been damaged or lost by fire.

Yet this positive protection costs little if any more than haphazard measures.

Let us send you details.

THE OIL CONSERVATION ENGINEERING COMPANY
877 Addison Road Headquarters for Tank Equipment Cleveland, Ohio
25 Broadway ..... New York O-S Building .....Casper, Wyo.
325 Iowa Building.....Tulsa, Okla. W. K. Henderson Co.....Shreveport, La.
Neilan, Abbey & Co. ....Los Angeles, Cal.

OIL TANK OCECO EQUIPMENT
SAVES EVAPORATION AND PREVENTS FIRE

Mention Where You Saw the Advertisement

Buy less freight—get full value

THE REASON FOR LOWER COST

The lower cost at which Texas Fire Brick is sold to Southwestern Refiners must not be construed as indicating an inferior product—it is merely the result of local manufacture and the attendant shorter freight haul. You save substantially on transportation..

EVIDENCE OF HIGH QUALITY

As evidenced by its use by leading Southwestern Refiners, Texas Fire Brick "delivers" on Quality.* In buying fire brick, Quality—the ability to "stay put," essentially has actuated these refiners in their choice of Texas Fire Brick. Added to this advantage is that of lower cost.

THE "PREMIUM" ELIMINATED

Previous to the use of Texas Fire Brick, the Refiner literally has paid, in the form of excessive freight, a price nothing short of a premium. Texas Fire Brick, made and used in the Southwest has eliminated that "premium." When you buy Texas Fire Brick you buy less freight and get full fire brick value. Next time meet your needs economically with

Texas Fire Brick

Equal to More Than 85% of Fire Brick Requirements

Let us tell you how Texas Fire Brick is being used, by whom, and to what extent it will serve you more profitably.

Write any office below of the

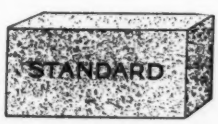
Texas Fire Brick Manufacturers' Ass'n

Promoting Greater Economies Through the Use of High Grade Texas Fire Brick

Athens Brick & Tile Co.
Athens, Tex.

Elgin Butler Brick & Tile Co., Austin, Tex.

Texas Clay Products Co., Malakoff, Tex.



Acme Brick Co., Ft. Worth, Tex.

*Names on Request

Phillips Petroleum Company

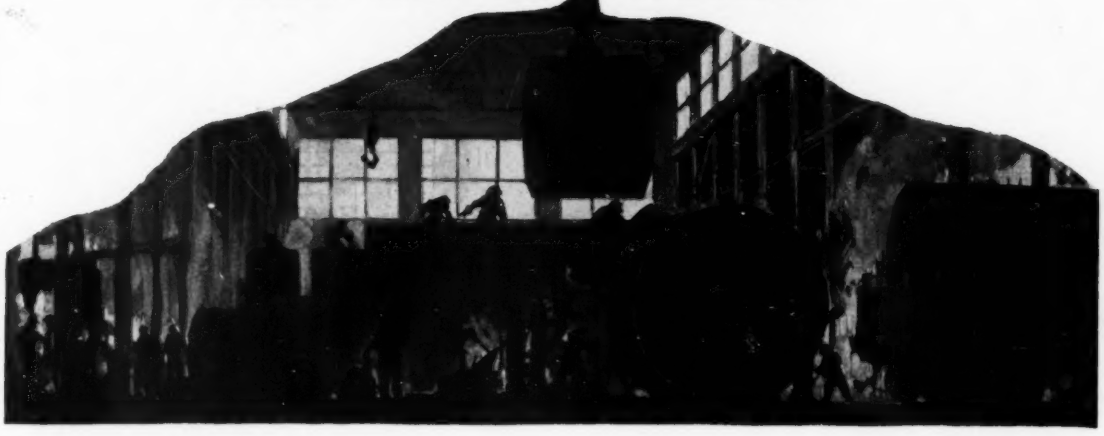
General Office

Bartlesville, Oklahoma

Producers of High Grade Crude Oil and Manufacturers of Natural Gasoline

Plants located throughout Oklahoma, Texas, Louisiana and New Mexico

There is No Safe Substitute for Real Skill



The Men Who Build KAW Refinery Products Are Masters of the Trade

Nothing can take the place of skill in the production of refinery equipment! The way in which your high pressure stills, storage tanks, etc., are built, counts for everything in their serviceable qualities.

That's why so many refinery men demand KAW Refinery Equipment. The men who construct KAW products are masters of the trade. Veteran steel experts who put all their years of experience into building better, stronger equipment.

That's why KAW products guarantee maximum service at lowest cost. Why they continue to maintain their operating fitness throughout years of use—saving trouble, worry and money for refinery men everywhere.

No matter whether your order be large or small—whether you want standard equipment or a special specification job—we assure you quick shipment, always.

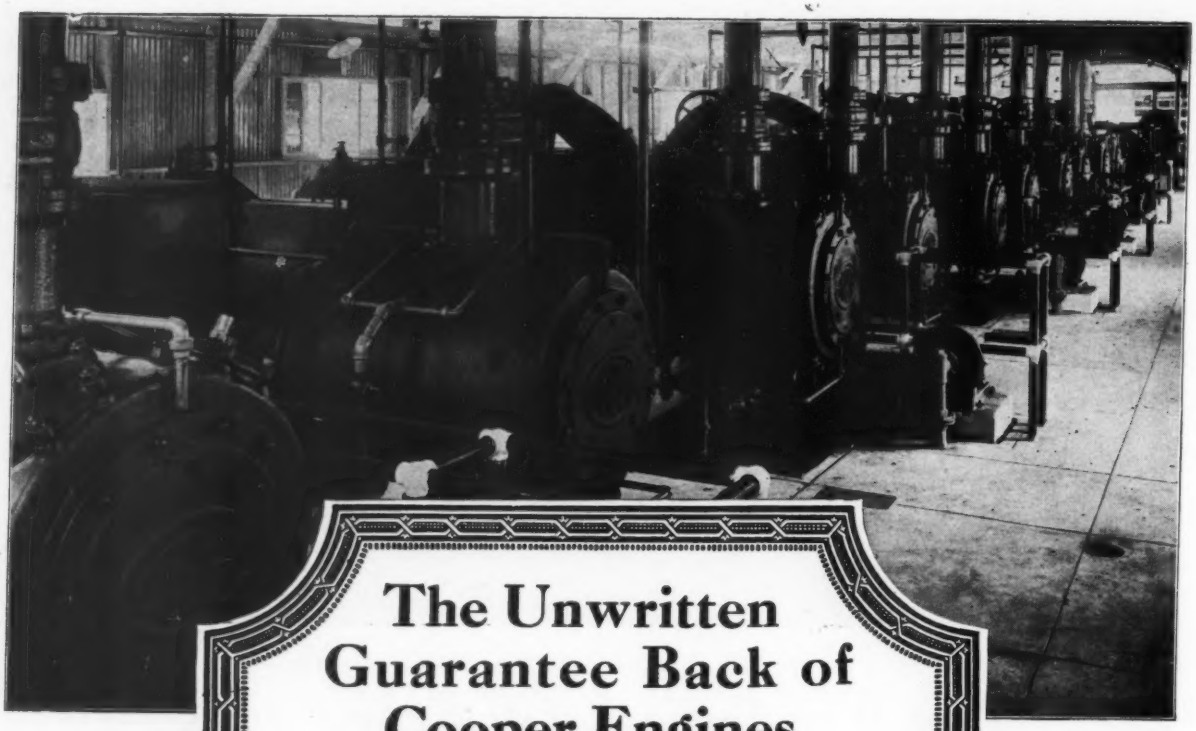
It will pay you to get KAW specifications and prices first. Write, wire or 'phone.

STORAGE TANKS
HORIZONTAL TANKS
AGITATORS STACKS STILLS TOWERS
CONDENSER BOXES
RUNDOWN TANKS

KAW

KAW BOILER WORKS COMPANY

General Office and Plant: 1st and Walker Ave. Kansas City, Kansas



The above photograph shows Pacific Gasoline Company's Inglewood, California, Gasoline plant which contains 5 Cooper Type-75 gas engines.

The Unwritten Guarantee Back of Cooper Engines

For ninety-two years there has grown without interruption a broadening confidence in the Cooper policy to replace or make good any piece of equipment that is ever found to have been defective at the time of its delivery. The reputation resulting from such a long continued policy is one of our priceless assets. It has many times been the deciding factor in influencing new accounts to favor "Cooper" especially when the service is as exacting as that required from gas engines.

The Texas Company are installing their first five Cooper engines in the Davenport Pool.

The Lone Star Gas Company are installing a new station, containing 18 Cooper engines, near Breckenridge, Texas.

THE C. & G. COOPER COMPANY, MT. VERNON, OHIO

1605 Kirby Bldg., Dallas

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317 Bank of Italy Bldg., Los Angeles

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The REFINER
and NATURAL GASOLINE MANUFACTURER
EDITED MONTHLY AT TULSA, OKLAHOMA
GRADY TRIPLETT, *Editor*
Published by
GULF PUBLISHING COMPANY
HOUSTON, TEXAS
R. L. DUDLEY, *President* A. L. BURNS, *Gen'l Mgr.*
Vol. 5 MAY Number 5

For men engaged in the operating branch of the refining and natural gasoline business

Price.....$1 per year

Advertising rates upon application to nearest office

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Gulf Publishing Co., 1925

PROGRAM

Fifth Annual Convention of the Association of Natural Gasoline Manufacturers, Tulsa, Oklahoma, May 5 and 6

MORNING SESSION
10 o'Clock, Wednesday, May 5

Address of Welcome .....F. L. CHASE
Vice-President,
Lone Star Gas Company, Dallas, Texas

President's Address .....E. L. PECK
General Manager,
Empire Gasoline Company, Bartlesville, Okla.

Report of Gas Testing Committee ....GEORGE P. BUNN
Assistant Superintendent Gasoline Dept.,
Phillips Petroleum Company, Bartlesville, Okla.

Report of Gas Contract Committee .....J. H. BOYLE
Secretary,
Chestnut and Smith Corp'n, Tulsa, Okla.

Appointment of Nominating Committee for Officers and Board of Directors.

Open Forum.
(Separate meeting for Petroleum Traffic Members, 10:30 o'clock.)

AFTERNOON SESSION
2 o'Clock

Paper, "Depreciation and Depletion for Gasoline Plants" .....A. B. MORRIS
Appraisal Engineer,
Chestnut and Smith Corp'n, Tulsa, Okla.

Discussion led by.....GEORGE F. WINTERS
Auditor,
Phillips Petroleum Company, Bartlesville, Okla.

Paper, "Research on Absorption Oil" ARTHUR L. DAVIS
Chemist,
Empire Refineries, Inc., Okmulgee, Okla.

Discussion led by.....A. F. MAXSON
Engineer,
Sun Company, Tulsa, Okla.

Paper, "Characteristics of Natural Gasoline as a Non-Detonating Agency" ....A. LUDLOW CLAYDEN
Research Engineer,
Sun Company, Philadelphia, Pa.

Discussion led by.....L. F. BAYER
Vice-President,
Tidal Refining Company, Tulsa, Okla.

MORNING SESSION
10 o'Clock, Thursday, May 6

Business Meeting.
Secretary and Treasurer's Report.
Report of Nominating Committee.
Election of Officers.

Paper, "Industrial Solidarity" .....W. R. BOYD, JR.
Assistant General Secretary,
American Petroleum Institute, New York.

Discussion led by.....D. E. BUCHANAN
Vice-President,
Chestnut and Smith Corp'n, Tulsa, Okla.

AFTERNOON SESSION
2 o'Clock

Paper, "Economic Value of Natural Gasoline to Refiner" .....DR. E. R. LEDERER
Vice-President,
Texas Pacific Coal & Oil Company, Ft. Worth, Tex.

Discussion led by.....S. C. CARNEY
Research Engineer,
Roxana Petroleum Corp'n, Tulsa, Okla.

Paper, "Relation of Volatility to Acceleration and Anti-Knock Qualities of Natural Gasoline"
DRS. E. H. LESLIE and G. G. BROWN
Professors of Chemical Engineering,
University of Michigan.
(Paper to be read by Dr. Brown.)

Discussion led by.....G. G. OBERFELL
Research Department,
Phillips Petroleum Company, Bartlesville, Okla.

NIGHT SESSION
7 o'Clock

Dinner Dance (Informal.)

Toastmaster .....JAMES A. VEASEY
Chief Counsel,
Carter Oil Company, Tulsa, Okla.

Principal Speaker .....C. C. HERNDON
Vice-President,
Skelly Oil Company, Tulsa, Okla.

The One Best Temperature as an INVESTMENT

The One Best Automatic Controller As a Preferred Investment

IN our last month's advertisement we told about a large Philadelphia textile mill ordering TAG Automatic Controllers as a *preferred investment*, on the advice of their Consulting Engineers, the Ballinger Company who calculated that these controllers, by providing The One Best Temperature in a battery of dyeing machines, will save ten thousand dollars a year on fuel alone — not to speak of many other advantages.

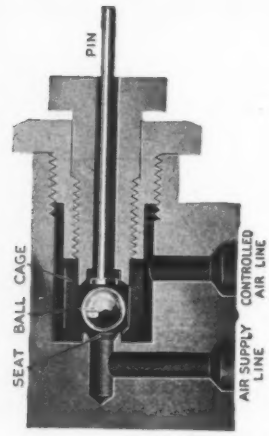
You, too, can get The One Best Temperature in *your* processes. You, too, can cut down the losses caused by human control.

And temperature is not the only vital factor: Consider the importance of pressure, of humidity, of liquid level, of time . . and of other conditions.

For every process there is only One Best condition. And for every application there is only one best automatic controller. The chances are that TAG makes it. TAG designed and built the first automatic controller for industrial process use twenty-seven years ago. Today, in 118 industries, thirty-three thousand TAG Automatic Controllers daily safeguard vital processes—outnumbering any other make.

Just take a look through the eighty-page TAG Automatic Controller Catalog: you will see no fewer than twenty-nine different *types* of TAG Automatic Controllers. Most of them come in various *forms*. And when you consider the possibilities of direct action and reverse action, and other combinations, and you get something like two hundred instruments to choose from. And each instrument is a preferred *investment*.

Yes, it certainly will pay you to send for Catalog B-900.



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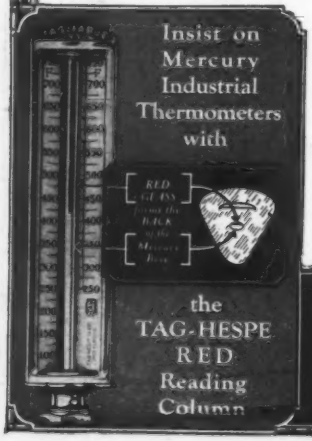

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From left to right—E. L. Peck, president, F. E. Rice, vice-presiden t A. M. Ballard, vice-president and A. V. Bourque, secretary, who comprise the official roster of the Association of Natural Gasoline Manufacturers

Organization Keeps Natural Gasoline on the Upgrade

By Grady Triplett

ONE day in the spring of 1921 a few men gathered for lunch in the Y. W. C. A. at Tulsa. Not that there is anything unusual in that, for the cafeteria there draws men every day.

But it so happened these men were engaged in the making and selling of the product that has come to be known as Natural Gasoline. Chances are those men were not in such high spirits. For the price of their product was down in the valley at that time.

It might not have been true of that particular day, but not many weeks previous "casinghead" gasoline was as low as 5 cents a gallon. It is not fair to say it was even that price. The truth of that situation was that "casinghead" gasoline stood on sidings in many cities of the United States, while its owners tried to sell it for 5 cents a gallon.

There have been reports that many tank cars of that product were emptied where they stood, rather than return them to the territory from which they were shipped.

Going Begging

Nobody wanted "casinghead" gasoline. It was the bad boy of the petroleum family. It had a bad name, part of it having been earned and part of it having been acquired.

Out of that luncheon meeting grew the Association of Natural Gasoline Manufacturers. Since its inception, the product has been through a redemption.

One of the first moves was to get rid of the name. The product was designated Natural Gasoline. A campaign was instituted to have the old name grow in disuse and that has been to a large extent successful. Only rarely does the term "casinghead" gasoline appear now.

But getting rid of a name was not the road to the seat of trouble. The product had to be good in quality as well as good in name. And that was where the specifications came in. Issuance of specifications was one of the first moves on the part of the Association of Natural Gasoline Manufacturers. While the organization has several accomplishments to its credit, the one of gaining a set of specifications is generally placed first.

Something New

It allowed those who might want to use Natural Gasoline to buy a product to meet their needs. Poor qualities of Natural Gasoline were eliminated through the specifications.

Another outstanding accomplishment of the Association was the type of program selected for its conventions. Necessity may have been the cause of this. But the Association of Natural Gasoline Manufacturers brought to the petroleum industry the type of convention program that allows technical and practical operat-

Reading left to right—A. J. Schlosser, H. A. Trower, Emby Kaye, John M. Hall, directors of the Association of Natural Gasoline Manufacturers

Reading left ot right—B. A. Whitney, M. E. Mockely, O. H. Schoenwald, and S. C. Carney directors of the Association of Natural Gasoline Manufacturers

ing men to come to a meeting, knowing there will be something of interest discussed there, and also knowing he may take part in that discussion.

Because the business of making Natural Gasoline is centered in a comparatively few concerns, membership in the association is not large. This in turn makes for low attendance at conventions, where only executives of the member companies attend.

So the Association of Natural Gasoline Manufacturers was faced with the problem of digging deeper into each company for its convention attendance. Plant operators were invited and attendance not restricted to men working for companies holding membership.

At the first of those there was a round table discussion of operating methods, which was a revelation to those responsible for the program. It showed that the man out in the plant is interested in his job.

Committee Activities

Since then each convention program has been of the type that allows discussion of the papers read.

That type of program also has another outlet and brought another accomplishment to the Association. If men were willing to come to a convention to discuss plant matters, why not take the means to them.

That brought the plant meetings, which have been held over the whole Mid-Continent area. In centers of Natural Gasoline manufacture, these meetings have been liberally attended, while the exchange of information has accomplished valuable ends.

Special committee work on gas meters, contracts and other subjects have resulted in valuable accomplishments on the part of the organization.

While the organization has devoted a great part of its activities to problems within the natural gasoline field, it has been of service to the whole petroleum industry through co-operation with other organizations. It has served with the American Petroleum Institute, the Western Petroleum Refiners Association, the Mid-Continent Oil and Gas Association, the Bureau of Mines, the Interstate Commerce Commission and other organizations.

The five previous conventions of the organization have been mile stones in the progress of this part of the petroleum industry. Every indication is that the convention of May 5 and 6, will be the most eventful of the list.

During the past six months, members of the association have been shaping affairs to the point of making an effort to place natural gasoline before the petroleum industry as a product whose economic position holds a key position.

One item in this is that of presenting facts concerning the non-detonating qualities of natural gasoline. This subject will be dealt with from several angles during the convention.

Then the economy of the use of natural gasoline will have a share of the program.

Action calculated to carry natural gasoline into even greater use is due for consideration at this meeting.

E. L. Peck, general manager of the Empire Gasoline Company, has completed a term as president of the organization. His election a year ago made him the third president of the association, as D. E. Buchanan, vice-president of the Chestnut & Smith Corporation, served two terms. The first president, W. M. Welch, also served two terms.

J. C. Smith, Gilliland Oil Company, was the first treasurer, H. S. Goddard of the Chestnut & Smith Corporation, was the next treasurer. He was followed by O. W. Crick of the Highway Oil Refining Company. At the last annual meeting the office of treasurer was combined with that of secretary.

A. V. Bourque has served as secretary since a few weeks after the organization was formed.

Reading left to right—H. R. Johnson, John W. Hurley, E. R. Lederer, and D. E. Buchanan, directors of the Association of Natural Gasoline Manufacturers

Natural Gasoline—A National Resource

By John M. Hall,
Manager Oil State Gasoline Company

OUR government and every individual is deeply interested in the conservation of petroleum and its products in our own country, as well as in the oil producing territories throughout the world. We have instances in the last century where governments and individuals unwisely or through corruption squandered, dissipated and diverted natural wealth and resources. Fortunately, the trend of modern times is toward conservation and the fact that the petroleum industry can be expected to do its part is shown in the increasing amount of motor fuel now being manufactured in which Natural Gasoline, i. e., gasoline made from gas as distinguished from gasoline made from crude oil, is playing no small part.

This article will deal briefly with the industry in general, calling attention more particularly to the natural gasoline industry which will be a vital factor in any petroleum conservation program of the future. The world very willingly admits American supremacy in the petroleum industry and we very graciously accept the honor, although we possess approximately only one-twelfth of the petroleum resources of the world, and the petroleum reserve of no other country has been so extensively drawn upon to meet foreign demands.

Conceding much improvement in the future in refining operations as well as in engineering achievements and inventions, the day is coming when our domestic demand will exceed our petroleum supply. Gasoline consumption is increasing at the rate of 16 per cent each year and doubles itself each sixteen to twenty years. Are we doing all possible to delay this day by conservation and is our government demanding and laying proper plans so that we will have the opportunity to explore and develop the petroleum resources of the world without discrimination—or are we just drifting? The part we will play in the future world development of petroleum will be largely determined by the extent we are permitted to enlarge our foreign exploration and develop and produce petroleum unhampered on foreign soil. Today our petroleum resources are open to the world, and it seems we should have a definite understanding as to what position other nations are to assume in the future with reference to their petroleum development, and govern ourselves accordingly.

Present Opportunity

One of the most immediate and practical opportunities for the conserving of petroleum in this country is the further development and use of natural gasoline which has already proven of great economic value. The Department of Commerce—Bureau of Mines—bulletin giving motor fuel statistics for the year 1925, reports 1,103,000,000 gallons of natural gasoline produced and used throughout that year, which was 9.83 per cent of all motor fuels produced. Seventy-five per cent of the natural gasoline produced was used in refineries, or 7.61 per cent of the total gasoline produced at refineries was natural gasoline. We hope that the above statistics together with the discussion which follows will enable you to realize the tremendous growth and development of this industry in the last few years and to see some of its capabilities as well as its possibilities.

For those who are not familiar with our product, permit me to explain briefly from what natural gasoline is produced, what it is, and how it is made. In the producing oil, gas is usually found in the oil producing formations or in close proximity, and after the oil flows or is pumped into tanks, the gas is produced either with the oil or comes out of the casing between the casing and tubing through the casinghead. This gas formerly was wasted into the air together with the gas produced with the oil—both a total loss and an economic waste. Its gasoline content which condenses in the lines and is both dangerous and unsatisfactory for use in the development or operation of a lease, together with its pressure which is insufficient to enable it to enter commercial gas lines, even if that were desirable, made it practically a worthless product. This is the gas from which natural gasoline is produced.

Source of Gasoline

A word of explanation as to how the gas obtains its gasoline content might be well at this time. The gas comes in contact with the oil either in the oil formation or on its way out of the ground and absorbs out of the oil some of its lighter gasoline properties or gases. The gas imbibes itself similar to a sponge thrown into water and its absorbing and cohesive attraction gathers some of the gasoline gasse or molecules of gasoline contained in the oil which unites thoroughly throughout the gas, thus becoming what is known as "Wet Gas." Originally this gas had a specific gravity or weight less than air, therefore, it is incapable of carrying any heavy ends of the petroleum, but to the contrary, absorbs only the lighter and purer gases of the gasoline content of crude oil. Even the more skeptical must admit the purity of gasoline produced under such conditions.

The three principal methods of extracting the gasoline content from gas are as follows:

1st. By compressing the gas through powerful compressors and then passing it through cooling coils which condense the gas into a liquid known as natural gasoline.

2d. By passing the gas through absorbing towers which contain a heavy absorbing oil that requires from 450 to 550 degrees of heat to start it to vaporizing. This is well over the end point of final distillaiton of natural gasoline which runs between 350 and 375, thereby removing any possibility of the absorbing oil when it is run through the still and heated to throw off its gasoline saturation which it has absorbed in the towers contaminating the gasoline vapors that pass through the cooling coil and condense into natural gasoline. The process is known as the Absorption Method. In many instances the Compression and Absorption methods are used together.

Use in Refineries

3d. By passing the gas though charcoal. This method is very similar to absorption through oil and equally proficient in avoiding any heavy ends getting into the natural gasoline. Most modern gasoline plants are equipped with treating plants which produce a Doctor Sweet product. It is now ready for market being graded both as to its distillation recovery which runs from 78 per cent to over 90 per cent and its gravity, which ranges between 72 degrees and well over 90 degrees. When it is convenient and profitable, the refineries purchase these grades and run them through their stills, thereby raising the lower gravities of their gasoline and naphtha up to commercial specifications ready for consumption. In this way they secure an excellent motor fuel. It is customary for refiners to put gasoline into storage

(Continued on page 96.)

Refinery Methods for Blending Natural Gasoline

By H. L. Kauffman
Consulting Petroleum Chemist

AT present there are few refiners who do not—in producing a finished, marketable gasoline—use natural gasoline (either in relatively large or small quantities) to make the finished product. The tendency to make and to market a finished gasoline by blending together natural gasoline with either straight run or synthetic ("cracked") gasoline, or both, has been increasing steadily during the past twelve years, and has been even more pronounced during the last six or seven years.

During the past year, however, a general movement on the part of several of the larger refiners to make a gasoline of higher gravity and of lower end point directly from the particular type of cracking unit installed in such plants (or re-running the pressure distillate obtained from such cracking plants, and then making "cuts" on the re-run stills so as to obtain a finished gasoline of higher gravity)—as a result of this tendency, a smaller percentage of natural gasoline is being used by refiners in the gasoline as now being marketed than heretofore.

Parenthetically speaking, it might be mentioned also at this point that another reason for the purchase by refiners from natural gasoline manufacturers of smaller quantities of natural gasoline—relatively speaking—than in preceding years is due to the growing tendency, in even the smallest refineries, for the refiner to increase the operating efficiency of his plant by the installation of modern equipment for recovering natural gasoline from uncondensable still gases.

Recent Tendencies

As a definite example of the changes being made by refiners in the grade of gasoline they are marketing, it might be mentioned that one of the largest producing, refining and marketing organizations in this country, a company that has facilities for the distribution of its products all over the world and one that (up until a very recent date) has specialized on the sale of a 56/58 gravity gasoline meeting in all other respects New Navy gasoine specifications—this company is now manufacturing and selling a finished gasoline of about 60.0 degrees A. P. I. gravity and 400 degrees F. end point—this then being blended with gasoline of the same end point, but usually of lower gravity, obtained from the particular crude that is being run. The gravity of the gasoline from the original crude oil (for a particular end point) is dependent upon the physical and chemical characteristics of that crude, and hence—to a certain extent—the gravity of the finished gasoline as marketed is dependent upon the gravity of the crude gasoline.

It is because of this recent tendency on the part of refiners to operate their plants along the lines above mentioned that relatively less than natural gasoline is being consumed by them than heretofore; especially, since the different types of cracking plants now held in high esteem by refiners are so flexible as to make possible the marketing of a finished gasoline of almost any gravity, although—true enough—from an economic standpoint, the maximum and minimum gravity limits of such gasolines are fairly well established.

The Parco Way

However, it is not the purpose of the writer in an article of this general nature to enter into any detailed discussion of the present economic situation of the natural gasoline industry, as well as its probable future. Instead, what I wish to do, is to describe briefly the general procedure followed by one refiner—Producers and Refiners Corporation at their Parco, Wyoming, refinery—in handling straight run, synthetic ("cracked") and natural gasoline—in the latter case, reference being made both to the natural gasoline that is made in the refinery from uncondensable still gases and that which is purchased from natural gasoline manufacturers—to produce a finished, maketable gasoline, these procedures being typical of the methods followed by many other refiners.

Producers and Refiners Corporation has in operation at Parco, Wyoming, a modern refinery having a crude charging capacity of 10,000 barrels of crude oil per day. However, at present—and during previous periods of time the refinery has been runnning an average of only between 4500 and 5000 barrels of crude daily, so that the discussion following will relate to the manufacture of a finished gasoline based on the operation of the refinery at the capacity mentioned.

Four different crudes are run at the Parco refinery, as follows: (1) Lost Soldier; (2) Simpson Ridge; (3) Craig, Colo.; and (4) Salt Creek.

Crude oil from the Lost Soldier, Wyoming, fields is the crude that is supplied to the refinery in larger proportions than any other—about 4000 barrels per day. Lost Soldier crude oil is a very "feakish" type of crude—one of the most unusual that has ever come within the experience of the writer. It has a gravity of between 30.5 deg. A. P. I., but contains only about 12 per cent of a low gravity gasoline blending-naphtha—48.5 deg. to 49.0 deg. gravity. With very efficient fractionating columns, as much as 15 to 16 per cent of a blending-naphtha (437 deg. F. end point), but from 45.5 deg. to 46.0 deg. A. P. I. gravity, can be obtained, although a naphtha of about 47.0 deg. gravity and of New Navy Specification end point seems to be the lowest gravity naphtha that proves economical and possible with the type of towers now installed on the crude stills at the Parco refinery.

Crude Characteristics

Simpson Ridge, Wyoming, crude oil is an asphalt base type of crude (22.0 deg. A. P. I. gravity) and contains no gasoline. An average of only about 200 barrels a day of this crude, which is valuable chiefly because of its zero cold test lubricating oil content, is run at Parco—and this, not daily, but representing the average amount charged to the stills at irregular intervals over a period of several months.

An average of about 500 barrels a day of crude oil from the producing fields near Craig, Colorado, is refined at Parco—the straight run gasoline from this crude, when made to meet "New Navy" distillation specifications, being between 56.0 deg. and 57.0 deg. A. P. I. gravity and hence not requiring the use of any natural gasoline blended therewith to produce a finished, marketable gasoline.

Thus far not a great amount of Salt Creek, Wyoming, crude oil has been refined at Parco, chiefly because Producers and Refiners Corporation's production in this field has been sold under contract to refineries located at Casper, Wyoming. Hence, straight run gasoline from this crude does not affect, materially, the procedures followed at the Parco refinery in blending up the gasoline as it is to be shipped. It might be mentioned, however, that New Navy specification, straight run gasoline as obtained from refining Salt Creek crude oil at Parco also is around 56.0 deg. A. P. I. gravity and consequently in this instance, too, no natural gasoline is required to be blended with it. Producers and Refiners Corporation's recent purchase of government royalty crude oil from the Salt Creek fields, approximately 50,000 barrels per month, which crude is to be refined at Parco, means that an increasingly greater percentage than heretofore of gasoline as shipped from the Parco Refinery will contain therein straight run gasoline which is naturally of high gravity.

Cracking Processes

Having outlined briefly the source and general characteristics of the straight run gasoline as made at the refinery under discussion, let us now observe the manner

in which synthetic or "cracked" gasoline is made.

Ten units of the Dubbs process type of cracking plant are installed at the Parco refinery, to which units are charged an average of 4000 barrels daily of 28.5 deg. to 29.0 deg. gravity residuum from Lost Soldier crude oil (or residuum of similar characteristics from other crudes, if available in appreciable quantities.)

These cracking stills are so operated ("non-residuum runs") that the only products obtained are pressure distillate, coke and uncondensable gases.

Either a single or a double distillation —and both have been followed at different times at this refinery—may thereafter be given the pressure distillate before a gasoline of proper distillation range is obtained.

Parenthetically speaking, it might be mentioned at this point that Producers and Refiners Corporation manufacturers and ships from their Parco refinery three direffent grades of gasoline, as follows:

1. "M-C" or Bearcat" gasoline—a 100% synthetic gasoline resulting from taking off and keeping separately a light cut when re-running pressure distillate.
2. Navy Specification gasoline—made by blending together straight run, cracked and natural gasoline (some of the latter being recovered in the refinery from uncondensable still gases; while whatever more is necessary is purcahesd from natural gasoline manufacturers.)
3. "S-D" gasoline—made by blending together straight run gasoline off Lost Soldier crude with purchased natural gasoline.

Running Methods

At times the pressure distillate as obtained from the Dubbs stills has been re-run without having been given a previous acid treatment and subsequently neutralization. In such cases, about 20 per cent of the pressure distillate was of good color (and hence was kept separately) and after "doctor" treatment was sold as "M-C" or "Bearcat" gasoline. The remainder of the pressure distillate—reduced down to 220 deg. F. flash bottoms (about 410 deg. F., I. B. P.)—was combined into what was knwn as "pressure distillate re-run." This "P. D. Re-run," then, was acid treated, neutralized and again re-run for a maximum yield of end-point gasoline—this, thereafter, either being mixed with other gasoline, sweetened. and the whole then blended with natural gasoline to raise the gravity; or, this heavy, cracked gasoline (of about 50 deg. to 51 deg. A. P. I. gravity) was mixed with straight run gasoline and the mixture as such used at the refinery absorption-compression plant to absorb the high gravity natural gasoline recovered from uncondensable still gases; after which the sour, high gravity gasoline thus obtained was sweetened and then was ready to be shipped.

The other procedure followed— this being the one now in use—is to treat the entire pressure distillate with sulphuric acid, neutralize and then re-run. On the re-run stills cuts are made for high gravity, so-called "M-C" gasoline (when there is a demand for this product) and a gasoline blending naphtha, which thereafter may be further processed in the manner described in the preceding paragraph. In any case, the gasoline as it comes from the re-run stills is sour and must be sweetened either before or after being blended up to a higher gravity and as such becomes a marketable gasoline.

Having mentioned the general manner in which straight run and cracked gasolines (usually of low gravity, however) are obtained at the Parco refinery, mention might now be made of the general procedures followed in blending up the low gravity product with natural gasoline to one of higher gravity.

Use of Natural Gasoline

A rather interesting departure from usual refinery practice at Producers and Refiners Corporation's Parco plant lies in the way in which the gasoline recovered from uncondensable still gases is utilized.

The refinery absorption plant is located in the extreme east end of the refinery and is situated not far distant from two 10,000-barrel sour gasoline storage tanks. In one of these tanks is stored a mixture of straight run and cracked gasoline—averaging between 52.0 and 53.0 deg. A. P. I. gravity. Suction is taken on this tank by a pump placed in the absorption plant building, and the heavy gasoline pumped therefrom is blended up in the coils (part of the absorption plant installation) with the compressed gasoline recovered from the uncondensable still gases until the whole is about 57.0-57.5 deg. gravity. It is then stored in the accumulator tanks until these tanks are filled after which this high gravity gasoline is blown to the other 10,000 barrel field storage tank. From this tank suction is taken by a pump placed in the continuous light oil treating plant building, the high gravity gasoline being sweetened in this plant and discharged steadily to one of several other fiinished-gasoline, field-storage tanks. This blended gasoline can be and has been (in fact, very frequently) sweetened successfully in the towers at the refinery absorption plant—in which case it becomes unnecessary to treat the product in the continuous light oil treating plant.

An average of about 20 million cubic feet of gas each month is received by the refinery absorption plant from the crude and pressure stills. From this gas is obtained an average of about 100 barrels daily of natural gasoline, which is blended up in the coils with an average of 1500 barrels daily of gasoline blending-naphtha —thus making a gasoline of higher gravity.

Blending Methods

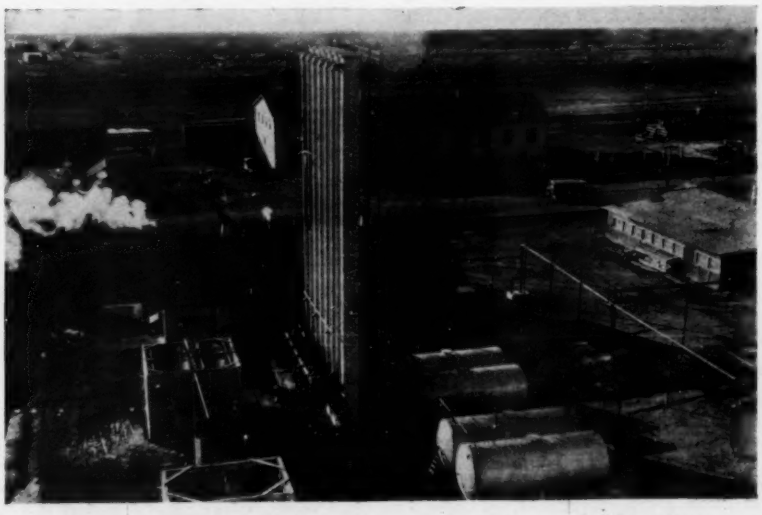
However, the natural gasoline obtained from the refinery absorption plant is not enough for the requirements of the refinery, and consequently an average of about 10 to 15 cars per month of natural gasoline purchased in Oklahoma is necessary to make up for this deficiency.

No unusual procedures are followed in blending up this natural gasoline. The gasoline is merely unloaded from the car by "blowing it out" with gas under pressure to the gasoline storage tank (containing low gravity gasoline) and thereafter blowing the finished gasoline tank with compressed air until a thorough mixture of the contents of the tank has taken place.

If this tank then receives laboratory approval for loading, suction is taken on the tank by a pump in the transfer pumphouse and the cars at the refinery loading rack are filled. However, if the tank is of higher gravity than is desired, so-called "blending at the pump" may be done by regulating the valves on the manifold in the pumphouse so that suction is taken simultaneously on a high and a low gravity finished gasoline storage tank, in which case the gasoline discharged from the pump will be exact gravity desired on the product as it is to be shipped.

Blending at the Pump

Blending at the pump possesses the advantage of being able to start loading on a very short notice, and without any previous expenditure of time or effort in getting a tank to the exact gravity desired ; less blowing of the high gravity tank is necessary (because it is of lesser importance as to whether or not the mixture is uniform throughout), and



Natural gasoline plant at the Parco refinery of the Producers and Refiners Corp.

How to Conserve Steam in Refinery

Paper delivered before National Petroleum Association at Cambridge Springs, Penna., April 15 and 16

By H. S. Bell,
Petroleum Engineer, New York

NO matter how efficient a refiner's boiler house may be, he must use the steam intelligently and without waste if he is to reap the full benefits. This paper will direct attention to the wastes that are often encountered in the steam distribution system and offer suggestions for conserving steam in the refinery.

In order to evaluate the losses and possible savings that follow, I have drawn upon the statistics now available from analyses of member companies' boiler houses. Taking conditions as they were found in 10 different boiler houses, fuel costs average 36 cents per 1000 pounds of steam. It is believed that this figure is fairly representative of member companies' plants.

To the above must be added labor, maintenance, supplies, depreciation and a percentage of general overhead. It is safe to say that these items will average 50 per cent of the fuel for the typical small refinery. This would bring the cost of steam to 54 cents per 1000 pounds, a figure which is used in the following discussion.

Certain losses are apparent to all but do we appreciate the amount of money involved?

Need of Insulation

Take the question of insulation; one lineal foot of bare pipe on a line conducting steam at 100 pounds gauge pressure will dissipate to the atmosphere the following heat units per hour, when the temperature is 60 degrees F.:

Diameter	B.t.u.
1 inch	301
2 inch	543
3 inch	799
4 inch	1027

For the average condition encountered, 1 pound of steam generated at 100 pounds with feed water at 150 degrees contains 1070 B.t.u. so the loss of steam per hour by the one foot of exposed pipe is as follows:

Diameter	Pounds of Steam
1 inch	.28
2 inch	.51
3 inch	.75
4 inch	.96

These figures do not appear very startling but let us put them in terms of steam and money lost in one year.

	Steam Lost	
	Pounds	Value
1 inch	2440	$1.32
2 inch	4470	2.41
3 inch	6580	3.55
4 inch	8400	4.54

We all acknowledge the value of insulation on live steam mains, but it is often thought that it is not worth while to insulate the exhaust steam lines. Let us analyze this question a bit. Heat losses are in approximately direct proportion to the difference in temperature between the hot and cool surfaces of the pipe. In the above examples, this difference amounted to 278 degrees. For 5-pound exhaust steam the difference is 168 degrees, so that for all practical purposes the losses are 60 per cent of those deduced for the live steam mains.

Remembering that these figures are for only one lineal foot of pipe and considering the nominal cost of covering, can any refiner afford to leave any of his lines or fittings exposed?

Reference to a standard price list for covering of 90 per cent efficiency reveals an average return of 472 per cent on $1.00 spent for work of this kind on the four pipe sizes in the above examples. Therefore, the cost is earned in about two and one-half months.

Little Leaks Costly

As we go around the refinery, we repeatedly see steam leaks. A very bad one receives attention, but the little ones are often overlooked in the belief that the loss is nominal and we can take care of it some time next week. Don't forget that the majority of leaks become greater and that even the small ones represent quite a loss in money.

For instance, the steam lost per hour from small leaks in a system operating at 100 pounds is as follows:

1/32 inch	4.4 lbs.
1/16 inch	17.7 lbs.
1/8 inch	70.1 lbs.

Not much loss we say, but apply our cost of steam over a year and the figures in dollars are:

1/32 inch	$ 20.63
1/16 inch	82.60
1/8 inch	327.40

These figures should spur every refiner to educate his men that a steam leak receives immediate attention.

While on the subject of leaks, the question of open drips brings itself to mind. They represent a prolific source of leaks. Remedy, efficient traps. Even the best traps will leak at times and that they may be detected, never run the discharge to blind drains or sewers. Let them discharge into catch basins or other receptacles where the discharge pipe is visible. Otherwise, how can we tell when some trap develops a leak of considerable financial importance?

The topics discussed so far have had to do with installation and maintenance of the steam distribution system. The next question to discuss is the way the steam is used for power and for process work.

Stills First

The proportion of boiler load going into the production of power in a refinery is relatively small when compared to most other manufacturing plants. The big use of steam is at the stills. Here is a real chance for educational work among the operators.

Steam has three functions when introduced into a still of oil; first, it lowers the vapor tension according to the law of partial pressures, thus reducing the necessary temperatures in the still; second, it agitates the oil in the still, thus preventing local overheating on the bottom of same; third, it has a beneficial effect upon certain distillates.

Considering the difference in equipment, in various plants, it is, of course, difficult to set up a standard for the minimum amount of steam necessary. For the average plant, I believe an amount equivalent to one pound per

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hence a lesser amount of gasoline is lost by excessive blowing than otherwise would be the case. But, blending to exact gravity at the pump from two different storage tanks possesses the disadvantage of requiring almost the entire time—or, at least, attention at regular intervals—of one man in seeing that a uniform gravity is resulting from blending in this manner, and making a slight change in the valves of the manifold if any variations are occuring in the gravity of the blended product.

Some refiners mention as an objection to blending at the pump that a permanent uniform mixture is not obtained, and that a stratification of light and heavy gasoline later may take place. Such instances have never come within the experience of the writer, so long as the products being blended do not vary by more than about 8.0 deg. A. P. I. in gravity. By that is menat that a gasoline of 52.0 deg. A. P. I. gravity can be blended at the pump with one of 60.0 deg. A. P. I. gravity to produce a 56.0 deg. gravity product, and that—in the experience of the writer—thereafter, in such cases, appreciable stratification does not occur.

gallon of distillate when first applied up to seven pounds when finishing stock, is sufficient.

These figures amount to a total of 140 pounds per barrel charged on a crude still run. Suppose for example that 15 per cent more steam was used than absolutely necessary. A refinery running 30 000 barrels per month would waste 21,000 pounds of steam on the crude stills alone. Without making detailed calculations, it is safe to say that a like amount would be lost on re-running and reducing operations, or a total of 42,000 pounds per day. This quantity of steam wasted at our previous figures, amounts to $8,300 per year.

Accuracy Best

We all know that the average still man will "give her all she'll take." Furthermore, his measure of the steam is "a quarter turn" or "one spoke" of the valve. Such measurements are crude in the extreme. It is time to get down to facts.

To set up the minimum quantity of steam for a given plant with due regard to quality, requires some careful testing. Assuming present conditions satisfactory, establish carefully how much steam is being used. The easiest way is to by-pass the water traps in the running lines and let distillate and water flow together through the lookbox. Catch a sample in a 500 or 1000 c. c. graduate and measure the water.

Then reduce the amount of steam 10 or 15 per cent and have the laboratory take samples of distillates and stock and see that the odor, color, etc., are not impaired. If satisfactory, make a further reduction. A point will be found to which it will be unsafe to go. Thus a standard is established for the conditions encountered.

Once established, how can this standard be maintained? If left to the turn of a valve, conditions will soon revert to the original. A small indicating flow meter inserted in the steam line leading to each individual still is recommended.

A complicated recording device is not wanted, but there are on the market simple indicating meters that can be installed at very nominal cost. When installed, check them occasionally by measuring the water in the steam.

Closed Coils Best

While on the subject of stills, the question of steam stills deserves attention. I am not an advocate of steam stills, holding that modern equipment using direct fire will accomplish the results more economically. Nevertheless they are a recognized piece of equipment and if we run them, we should do so intelligently.

It is surprising to see how many refiners depend entirely upon open steam sprays in the still. The use of closed coils properly trapped is strongly recommended. Depend upon the closed coil to supply the heat and use only enough open steam to lower the vapor tension and help sweeten the oil. Then all of the latent heat of the steam from the coils is turned into useful work.

With open sprays along, particularly at the end of the run, a large proportion of the steam "blows through" and goes to the condenser with the distillate. The heat given up by a pound of steam passing through the oil is only 3 to 4 per cent of the heat given, if the same pound of steam is condensed. Furthermore, the load on the condensers is increased resulting in the necessity of more water circulated.

Use of Exhaust

After the stills, the next place where quantities of steam are used is the engines, pumps and compressors. These prime movers return approximately an equal number of pounds of exhaust steam. I wonder if it is thoroughly understood how much heat there is in this exhaust. Neglecting moisture, one pound of exhaust steam contains 96 per cent as many heat units as does one pound of live steam at 100 pounds gauge pressure. Are we any more justified in wasting this heat than we are that contained in live steam?

If no other means are available, a portion of this exhaust steam should be used to preheat boiler feed water, and a refinery with feed water under 210 degrees should take steps to see what is the matter. The balance of the exhaust should be utilized for heating buildings, hot tanks, etc., and not a pound should be allowed to escape.

I presume some of you are thinking this idea may be all right, but we tried it on such and such, and had to go back to live steam. If so, let us ask the question—"Was the failure due to the exhaust steam or due to the equipment in which we tried to use it?"

To convey exhaust steam requires larger pipe than for live steam; also for a given amount of radiation slightly more surface is needed. Then allowance must be made for fluctuations in the quantity of exhaust steam available.

The solution is to modify the mains and coils and then install a pressure regulating valve in a by-pass between the live and exhaust steam systems.

Let us carry the use of exhaust steam a step further. Why not use it in the stills? The problem is simply to get enough volume into the still to accomplish our purpose. The pressure back of the control valve rarely exceeds, or at least should not exceed, 5 or 6 pounds. Why carry 60, 70 or 100 pounds on the main? Again, it is a question of coil and header design only. Five plants coming under my direct observation are operating their stills on exhaust steam and have been doing so for various periods up to nine years. Several other large modern plants are reported to be so operating.

One feature of introducing exhaust steam into stills must be thoroughly understood. Exhaust steam carries considerable moisture and is lower in temperature than live steam. In running to stock, let us assume that the average temperature of the oil in the stills is 425 degrees during the period while steam is being introduced. Exhaust steam is around 225 degrees in temperature. Obviously, its introduction retards distillation, while the steam is superheated and the moisture is evaporated.

Superheat First

To go back to our previous figure of 140 pounds of steam per barrel, a 500-barrel crude still will take 70,000 pounds of steam during the run. To dry the 5 per cent moisture and superheat 200 degrees will require 9,590,000 B.t.u. which heat is robbed from the oil and must be made up by firing more fuel. At 25 per cent still efficiency (a lamentable but approximately correct averaging 1½ extra tons of coal are required during the run.

Furthermore, the distillation is retarded. Anything that retards distillation and results in longer exposure of the oil to heat, is detrimental to color and quality.

Therefore, if exhaust is used, it should first be superheated to a temperature as high as can safely be used; 450 to 500 degrees is all right. Tests have shown that 12 per cent of fuel is saved, and 20 per cent better time made when running with the steam superheated. Furthermore, a better quality stock results on account of the shorter time that the oil is exposed to heat. As to the cost of superheating, there is no operating charge if waste heat is used, and what better opportunity than to use the hot flue gas from the stills?

The same reasoning will apply to the use of live steam in a still, although the savings are not as much due to lower moisture content and higher initial temperature. In my opinion, it will pay to superheat any steam that is used in distillation.

A Model System

With the past remarks in mind, I want to take just a few moments more in depicting briefly a model system for the distribution and use of steam in an oil refinery.

There will be two main steam distribution headers through the yard. One will be under full boiler pressure and will feed all prime movers such as turbines, engines, steam pumps, etc. The other system will collect all of the exhaust steam from the prime movers at 15 to 20 pounds pressure. This exhaust will be conveyed to a central point where waste heat is available to bring it up to 450 to 500 degrees in temperature and will then distribute it to stills, heating coils, refrigerating machinery, etc. Between the two systems will be a positive acting automatic regulator so that the low pres-

(Continued on page 84.)

One Man Dead and Two Men Alive

Being the true account of three industrial accidents in gasoline plant and refinery

By Roye Munsell
Staff Representative

EARLY in December, 1925, at a gasoline plant operated in Southern Kansas, an employe was sent to a meter house to change an orifice. Orders to the contrary notwithstanding, the man did not take a helper along and went into the meter house alone. After some time his fellow workers missed him and started a search. They found him in the meter house overcome with gas and apparently lifeless.

The victim was carried out and his fellow employes not knowing how to go about restoring life at once, called a doctor. The doctor had to come from a town several miles distant from the plant, and when he arrived after a time, he pronounced the man dead from asphyxiation —*and he was buried.*

Method of changing operators in restoring respiration. Picture taken during First Aid Contest at International Petroleum Exposition

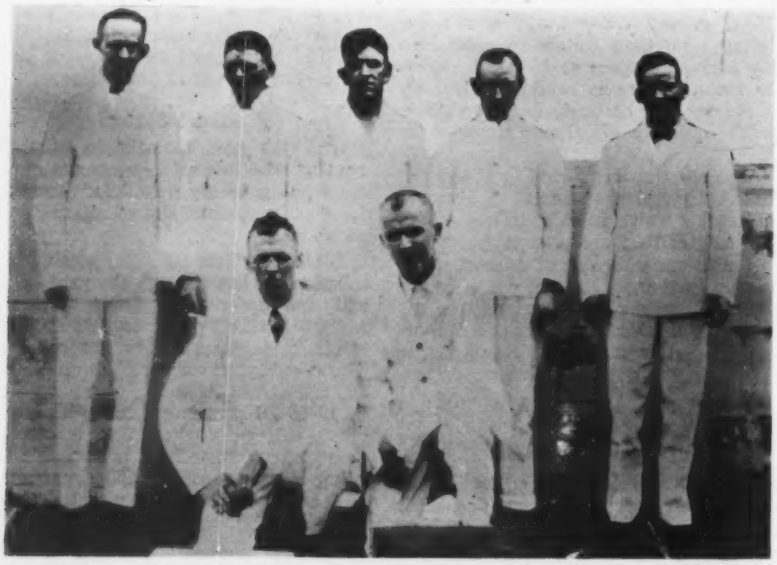
A Life Saved

On January 20, 1926, a brick mason's helper was working on one of the stills of the West Tulsa refinery of the Mid-Continent Petroleum Corporation (formerly Cosden.) Due to incomplete combustion in the fire box of an adjoining still the man was overcome with carbon monoxide, the most deadly of common industrial gases. When found and carried to safety the victim was apparently dead as a result of asphyxia.

Among his fellow workers, however, were members of the refinery's First Aid team and artificial respiration was immediately started. After only a few minutes the apparently dead man was revived—*and is now in good health and none the worse for his experience.*

The moral is: First Aid safety work pays and pays in the specie of infinitely valuable human lives saved.

On January 27, 1926, the same thing which happened to the brick mason's helper happened also to a welder at the West Tulsa refinery of the Mid-Continent Petroleum Corporation. The welder was likewise badly gassed, and to all appearances dead, but First Aid administered in time by co-workers revived him and he is well and also very much alive today.



This team from the West Tulsa refinery of the Mid-Continent Petroleum Corp., put its first aid training into valuable use by saving two lives of fellow workmen. Members: Front row, left to right, R. C. Spore and R. F. Kneidel; back row, William Middleton, R. M. Thomas, Sam O'Brien, J. A. Milligan and C. C. Woodruff

Credit to Council

The Petroleum Safety Council of the Mid-Continent Oil and Gas Association deserves a great deal of credit for saving these two lives, for it was through their efforts that the First Aid training was given to the men who did the actual work of resuscitation.

Since the summer of 1925 the Petroleum Safety Council, under the direction of Ray E. Miller, has made a strenuous campaign toward training employes of the industry in First Aid work.

The United States Bureau of Mines has also gladly furnished trainers to the industry and the services of its men are always available by application of the employers.

Many lives are lost every year just because no person is at hand who has knowledge of the best thing to do when a person is unconscious on account of poisonous gases, electric shock or drowning.

No one knows whether or not the spark of life was still burning in the man who was overcome in the meter house, but there are few cases on record where a person was not revived as a result of such an accident, due to more or less deficiency than absolute lack of oxygen, if artificial respiration was applied at once.

Don't Wait—Work

To wait for a doctor or a pullmotor is to court death. By that time it is almost

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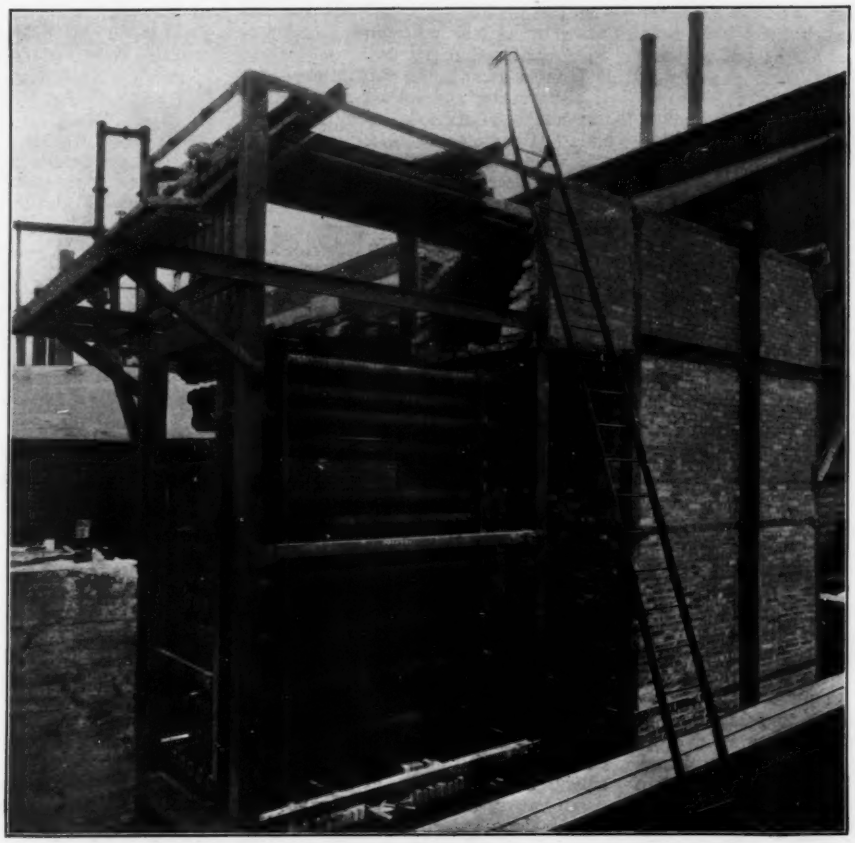

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certain to be impossible for any later treatment to restore suspended breathing.

Asphyxia, or death from suffocation or lack of oxygen by the tissues, occurs with lamentable frequency these days, and there is no doubt but what many lives are needlessly sacrificed because of the ignorance on the part of co-workers, bystanders, or even members of the family, of the best and only restorative procedure.

There are several methods of applying artificial respiration to human beings. The Schaefer or Prone method is most effective and to be recommended because of its ease and simplicity.

The following description of the Schaefer method is quoted from the Manual of First Aid Instruction, issued by the Bureau of Mines: Place the patient on his abdomen; remove from his mouth all foreign bodies, such as false teeth, tobacco, and gum; the tongue usually falls forward of its own weight, but see that it is forward; turn his head to one side and rest it on the forearm, so that the mouth and nose will not come in contact with the ground, and extend the other arm forward.

How It Is Done

"If the person is thin, prepare a pad of folded clothing, blankets, or cloth, and place it under the lower part of the chest. Do not make this pad too thick. Do not wait to loosen the victim's clothing, but begin artificial respiration without delay. An assistant may remove all tight clothing from the victim's neck, chest and waist.

"Kneel, straddling the person's thighs and facing his head; the palms of the hand are placed over the short ribs with the thumbs parallel with the spine about two inches apart and your fingers spread out as much as possible, the ends of the little fingers reaching just below the last rib; with arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear on the person. This operation, which should take about two seconds, must not be violent, lest the internal organs be injured. The lower part of the chest and also the abdomen are compressed and the air is forced out of the lungs. Now immediately swing back slowly to remove the pressure, but leave your hands in place, thus returning to the first position. Through their elasticity the patient's chest walls expand and his lungs are thus supplied with fresh air. After two seconds swing forward again and repeat deliberately about 15 times a minute, the double movement of compressing and releasing—causing a complete respiration in about four seconds. If a watch or clock is not available, follow the natural rate of your own deep breathing, swing forward with each expiration and backward with each inspiration."

Keep It Up

Bear in mind that the purpose of the treatment is to get fresh air into the lungs. Animation of the individual is suspended because the breathing muscles have failed to function. Life is being restored by making the lungs to work.

It is essential to success to remember that artificial respiration should be given immediately and should be prolonged even some time after all hopes of restoration have been given up.

There is the well known case of the drowning man who, after being removed from the water and pronounced dead by a reputable physician, was revived by artificial respiration given by a friend who refused to give up hope.

Good to Know

The United States Life Saving Service continues treatment four hours, if necessary. Of course, after the heart has stopped beating completely, restoration is impossible. An untrained person, however, ought not to be disappointed by apparent cessation of heart beat, since the heart of an individual asphyxiated is likely to be gorged with extremely dark venous blood, and therefore very slow and feeble in movement. It is this dark blood which gives an asphyxiated person his characteristic blue color.

The value of knowing how to apply artificial respiration can hardly be overestimated. You should encourage your co-workers to learn it, because the knowledge or ignorance of it may be the vast difference between death and continued living to you. You should teach your family how to apply artificial respiration because one never knows when some one at home as well as at work may be overcome by poisonous gases, electric shock or drowning.

History of the Gas Engine

By A. J. Schlosser,
Barnesdall Oil Company

Paper read before the Oil and Gas Power Conference of the A. S. M. E. at Tulsa, April 24

BY request, the subject of my paper is the gas engine. I kindly ask you to bear with me in referring back to make comparison of early developments and present day progress.

During all of the history of early gas engine experimenting there was no mention made of natural gas, even though natural gas has been known in foreign countries since ancient times. The earliest record is during Julius Ceasar's time. Gas wells were drilled 2000 feet in China in 615 A. D. Gas issuing from fissures was worshipped by the inhabitants. The city of Genoa, Italy, was lighted by natural gas at about the same time. In the United States natural gas was first commercially used in 1821, and Fredonia, N. Y., was supplied from a well only twenty feet deep. It was first used for manufacturing processes in 1863 at East Liverpool, Ohio. The first natural gas pipe line was built in 1876 to Titusville, Pa., from a well 786 feet deep. This was a two-inch line, five miles long. In the same year a nineteen-mile line was constructed from Butler to Pittsburgh, to supply gas in the steel mill.

Gas Engine History

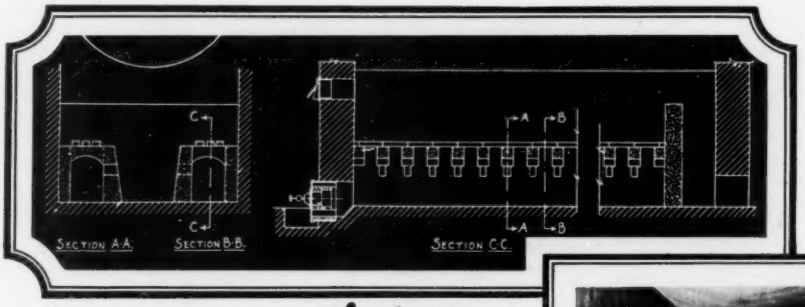
The origin of the gas engine is but imperfectly known. History dates back to 1680, when Huggens proposed the use of gun powder for obtaining motive power. Papin in 1680 continued Huggens' experiments but without success. The method used, the explosion or impulse was used indirectly. A small quanity of gun powder exploded in a large cylinder filled with air, the air being expelled through check valves, thus leaving a partial vacuum in the cylinder. The pressure of the atmosphere acting on the opposite side of the piston, thus creating energy.

The Barnett engine compressed the air and gas separately, mixing and ignition taking place in a receiving condenser which in turn supplied the main cylinder with the hot gases through automatically opened intake valves. The third engine described by Barnett was identical with the other, except that the receiving chamber for the mixed gases was eliminated and the air and gas pumps delivered separately in the right proportions into the main cylinder instead of the receiving chamber and explosion of the gases being in the main cylinder, while in the first the explosion of the mixture took place in the received and the hot gas and air then delivered to the engine main cylinder, the same as steam is now used from a boiler into the engine.

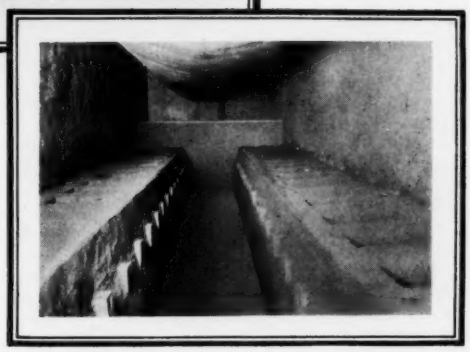
A complete description of those engines is too long for mention here, but what I can gather from same, the appearance of the engine is similar to the old fashioned home made beam connected oil pump constructed of pipe fittings and check valves. All cylinders being set on a table and the fly wheel being located on a cross brace of the table legs. The mixed gas in the receiver tank in the Barnett engine was about 25 pounds. A scavaging device was arranged and air compressing cylinders were made in excess sizes for the purpose of discharging a portion of the air through the receiving tank after each explosion to clean the receiver of the burned gases. This method of scavaging in the main cylinder is largely used in the modern engine. In one experiment Barnett describes a third auxiliary cylinder operated exclusively for scavaging of the burned gases from the receiver.

Compared With Steam

The Barnett engine in short explanation operated on the following principle as compared with the steam engine and boiler of the present day. Instead of steam from the boiler, the mixture was explod-



A Plibrico Diffusing Furnace; note "doghouse" combustion chamber.



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ed in the boiler and the pressure driven therefrom was consumed in the main cylinder thereby creating a motive force. The ignition being hard to explain, composed of internal and external flame and controlled by mechanically actuated stop which alternately opens simultaneously with the cycles of the engine to the inside of the compression chamber then to the outside or atmosphere, to be re-lighted after each power stroke.

From 1838 to 1854 there were eleven British patents applied for; some were never completed. Of all these, by far the most important was Barnett's. The others only tended to show that the gas engine promotion was receiving more attention. In 1855 Newton proposed a new interesting form of ignition which is described as identical to the invention of the of the American, Mr. Drake. It was used on double acting engines which took the air and gas mixed at atmospheric pressure directly into the main cylinder and the ignition was caused by the thimble shaped piece of cast iron which projected into a recess formed in the side of the cylinder and was kept at all times red hot by a blow pipe flame and was controlled by the piston of the main power cylinder. When the piston uncovered the recess the explosive mixture was given contact with the ignition thimble thereby causing ignition. This was the first record of ignition by contact with hot metal. The Diesel engine of today is operated on this principle, also this same developed into the hot tube which was for many years the most reliable ignition for gas engines.

In 1857 Barsanti and Matteucci came out with the new design described as the first free piston engine. Instead of allowing the explosion to act directly upon the motive power shaft through a connecting rod; the piston is perfectly free in a long cylinder placed vertically. The explosion of mixed gases is created under the piston and the piston is driven upward in the cylinder without limit or restriction to the end of the expansion. The piston rod in this design is rack gear connecting to ratchet gear wheel on the main shaft, and after the explosion the weight of the piston and partial vacuum in the cylinder equal the amount of power created during the return stroke.

The method although indirect, was fairly economic, having rapid expansion, practically complete expansion and some of the advantages of a condenser in the cooling of the gas on the return stroke. An external scavaging pump was used in connection with this engine. Up to 1860 the gas engine was practically speaking in the experimental stage. Many attempts were made, but none of the inventors succeeded in overcoming the practical difficulties. This was mostly due to the serious nature of the difficulties and the ambition of the inventors, as they not only intended to compete with the steam engine, but to displace it entirely for both large and small power requirements; this was clearly shown in the description of the applications for patents. Up to this time the greatest credit for improvements was due Wright and Barnett.

A Working Engine

Next came Lanier who carries the honor of having introduced to the public a gas engine which actually worked. Nothing was incorporated in this engine that had not been proposed by the other inventors, but Lanier's real credit consisted in overcoming the practical difficulties sufficiently to make previous proposals fairly workable. His engine was the simple and ordinary high pressure steam engine with valves arranged to take in and discharge the products of combustion. The engine was demonstrated in Paris in 1860. Its economy was only about half that obtained by steam. In August, 1865, it was published in the Practical Mechanic's Journal that the engine was a success and that between three and four hundred of them were in operation, sizes ranging from one-half to three horse power. Lanier also built an experimental road carriage impelled by one of his engines. It was repeatedly run about the works where it was built and also made a trip from Paris to Joinville Lepont and returned in three hours. Lanier had also installed several engines in boats. His patents were obtained by J. H. Johnson in 1860. It described closely the engine as made both in France and England. The subject patent 1861 does not seem to have been carried into effect.

The uneconomic operation of the engine caused much speculation, but the true reason was fully explained by Gustave Schmidt in a paper read before the society of German Engineers in 1861. He states that the result will be far more favorable if compression pumps worked from the engine compressing the cold air and gas at three atmospheres before entering the main cylinder, by this a greater expansion and transmission of heat is possible. Millian, a Frenchman, concieved the advantages of compression and considered himself the first to propose its use in a gas engine, apparently unaware of the existence of Barnett's engine and patents. He claimed the exclusive right to use compression, in the most emphatic language. The description of his first engine seems to be exactly what Schmidt proposed. The compression space of a gas engine cylinder was at that time described as the cartridge, or charging chamber. A long description of Schmidt's and Millian's experiments are here omitted.

Looking to Compression

The compression idea at this time was evidently attracting attention because in 1862 Beau De Rochas published a pamphlet in Paris in which he advanced a step further than Millian with reference to further economy, and states with an explosion engine four conditions are required. The greatest possible cylinder volume and the least possible internal surface exposure. The greatest possible rapidity of expansion and the greatest possible expansion, and the greatest possible pressure at the beginning of the power stroke or point of ignition. In using boiler tubes the efficiency of the heat transmitted increases with reduction in diameter of the tube. In case of the gas engine cylinder, therefore, the loss of heat of explosion would be in inverse ratio to the diameter of the cylinder. Therefore, an arrangement which has a given consumption of gas demands cylinders of the greatest diameter and will give the most economy of the least loss of heat to the cylinders. One cylinder only should be employed in such engine, but loss of heat depends also on time. Cooling therefore will be greater where the working speed is slower.

An arrangement capable of combining these conditions consists of using large box cylinder and reducing resistance of the gases to a minimum. This leads to the following series of operations: Intake during the entire outstroke of piston; compression during the entire instroke ignition at dead center and expansion during the second outstroke and the exhaust gases to be forced out of the cylinder on the second return stroke. This is descriptive of a single acting four stroke type gas engine as used today. Next came the Hugons engine produced in 1865, which is similar to Lanier's. Then in 1867 Messrs. Otto and Langen. This engine was the best up to that time and held almost the entire command of the market for ten years, during which time several thousand were constructed. Brayton gas engine appeared in America next in 1873 and was of very little consequence.

The Electric Spark

Millian's paper in 1860 is the first mention of using an electric spark for ignition. C. W. Sumens, patented in 1862; Hugon's in 1866; Otto appeared in 1866, Otto and Langen in 1867. Briefly described: Two cylinders, one power and one compressor. Gas and air were compressed into a receiver 60 to 80 pounds pressure, the mixture passing to power cylinder. Ignited as it enters, a grating arrangement preventing flash back into receiver, the continuous flame only entering cylinder. This is the first two stroke type record in operation.

Many other inventions of minor importance which are too numerous to mention appeared in the next few years. In 1886 another line was found by Otto and Schoendorg. That of the development of the Otto cycle for use of heavy oils. That is, oils such as are used in lamps of high flash point. Priestman in England made the first successful engine which had spray vaporizer and electric ignition. This was the beginning of the Diesel engine and most leading makers of gas engines in England and America today manufacture both heavy and light oil engines as a part of their manufacturing business. In 1878 J. Emerson Dawson designed the complete pressure gas plant in which he intended to make fuel gas in sufficient quantities for factory and domestic requirements. In 1881 he applied his apparatus to supply gas for gas engines. The plant consisted of a closed producer containing anthracite coal, a boiler to raise steam, a cooler, scrubber and gas holder. At that time the largest gas engine built was about 20 H. P. and was called by the journals of the day, "King of Gas Engines." Dawson's gas producer had a profound effect on the development of the gas engine, and speedily lead to the construction of larger engines because his method of gas produc-

tion supplied fuel at a much lower cost per heat unit than had heretofore been obtained. From Dawson's gas producer sprang the suction gas producer first placed on the market in practical form in 1894 by Banier of Paris, which by far outclassed the pressure producer. Nearly all large makers of gas engines now manufacture suction gas producing plants.

Large Engines

In 1895 H. B. Thwait demonstrated that the so-called waste gases from blast furnaces could be used in gas engines, which lead to the design and construction of large gas engines now common over the country. It appears from his experiments that surplus gas from the blast furnaces of Great Britain is capable of supplying at least one million horse power continuously day and night and the same available furnace gas in America is capable of supplying about three and a half million horse power continuously. Thwait's system was put into operation in 1895 at Glasgow Iron Works and was successfully applied. For many reasons it did not take well in England but in 1898 there was applied near Liege one designed by M. Delomore de Bautefille to utilize blast furnace gas of 110 B. T. U.'s per foot. The engine had a single cylinder 31½ inches diameter, 39½ stroke, 213 H. P. at 105 R. P .M. The practical knowledge gained from the design and application of this engine proved the gas engine industry from an approximate thermal efficiency of 16 per cent to 35 per cent. While the Otto cycle engine was developing, inventors were hard at work on the two cycle engine in Great Britain. This work fell mostly on Clerk Robson and Atkinson. While on the Continent the most persistent worker on this line was Courting. The conclusions of Courting were classified as follows: Explosion acting on piston connected to crank Compression with increase of volume after ignition but at constant pressure. Compression with increase of pressure after ignition but with constant volume. It was proved efficiency of the comparative types are 21-36-45. The first method of heating was supposed to be involved at once and high temperature produced. Second heat involving gradually so as to give lower temperature and pressure sustained throughout the stroke. While the third method the heat was instantaneously increased at the point of ignition and volume expanded as the piston moved forward. Otto stated that this gradual evolution of heat may be produced by stratifying the charge of gas and air instead of using the homogenous charge of Lanier and Hugan. Otto used a charge he states was heterogenous. He affirms his invention lies in the method of forming this stratified charge in the gas engine cylinder and that in addition to the explosive mixture there is present in the cylinder a mass of inert gas which does not burn, but which serves to absorb the heat of the explosion, and prevent the loss which would otherwise occur by the cooling effect of the cylinder walls.

Manufacturing Begin

Dr. Slaby published a report describing the advantages of Otto's invention as: The essence of the invention consists of a definite arrangement of the explosive gaseous mixture in conjunction with inert gases remaining in cylinder after exhaust so as to suppress explosion and insure ignition, the richest mixture lying at the point of ignition. After discharge of the exhaust a portion remains in the clearance space of cylinder and this constitutes the layer of inert gas next to the piston, thus forming a cushion saving the piston from the shock of the explosion of the strong mixture. Stratification of the charge was claimed to cause slow ignition and continue burning while the piston moves forward (temperatures of gaseous mixture vary from 1600 to 3000 deg. F., depending on pressures and time) thus resulting in a greater mean effective pressure, this was incorrect as the time and absorption of heat by the cylinder walls makes the loss greater in some engines than in others. Mixtures of one part coal gas to nine to twelve parts other gas were used, the one to twelve being used in the Otto engine and is most intensively explosive of said range. Extracts from publications of Dugald Clerk 1886 raised in 1896 and 1908 the above from early edition for the purpose of setting forth some of the difficulties in the early days of gas engine development.

Cockerill was about the first large gas engine builder and at the end of 1899 had in operation at Differdinger nine engines, three driving electric generators and six driving blowing engines, on blast furnace gas, of Otto cycle single cylinder vertical operating at 90 R. P.M. and developed 600 H. P. brake, cylinder diameter 51.2, stroke 55¼ inches. They were huge gas engines at that time, diameter crank shaft 18¼ inches, diameter piston rod 9.6 inches, height 36 feet, width 20 feet, total weight 125 tons. Note piston speed of this engine, 833 feet per minute still the standard piston speed of the present day design of stationary power units. It has long been considered 100 foot piston speed an absolute limit.

Public Doubtful

In this same year, I started work in a machine shop manufacturing gas engines from 3½ to 180 H. P. In 1900 we built one 250 H. P. It was two cylinder, 23x 24 run at 184 R. P. M., operated belt connected generators, vertical, and exhibited same at the Pan American Exposition. It furnished power at the Exhibition. Three of these engines were installed at Stoneham on six months trial, subject to acceptance if service was satifactory. Operators were scarce and they were hard to sell, as most power users believed they would run only by a streak of luck. It took years to convince the public that they could be depended on. Conditions are much different now, nearly all oil field men understand them sufficiently to produce good service.

Referring to 1881 Dawson, 20 H. P. King and present day blast furnace gas engines; in visiting with Mr. B. F. Palmer, who was an erecting engineer for Westinghouse for many years, later with Bethlehem Steel, now has offices in the Tuloma Building, he explained that in 1916 Schwab paid nine and a half million dollars for an idle steel plant at Lebanon, Pa., and that he at once proceeded to install gas and oil engines to generate the power required. Two Westinghouse, 1750 H. P. gas engines were purchased, remodelled and installed to operate on blast furnace gas of 110 B. T. U.'s and coke oven gas of 400 to 440 B. T. U.'s. Many difficulties in operation were encountered, but Mr. Schwab had confidence in Mr. Arthur, his Chief Engineer, and a power house was built and foundations constructed for 55 units of 5500 H. P. each, of which 28 single and twin engines were erected. The cylinders were 47″x 60″, fly wheel 28 feet diameter, weighing 120 tons, crank shaft 110 tons, armature of generator 500 tons, main frames 120 tons, R. P. M. 70 for blowing, 90 for electric. The cost of power per K. W. hour was reduced about 89 per cent. The power was a continuous stream of trouble, generally contributed to misdesign, but truly speaking gas engines of this size are still to some extent in the experimental stage.

Purifying Plant

Gas purifying plant was constructed as follows: Four concrete pits 82′x77′, 9 feet deep, 34 inches thick, containing 241,-340 Cu. Ft. each. They were filled with wood shavings and iron and used in series. So designed that three would serve the requirements while the fourth was being cleaned and connected that gas could take single series or parallel passages through the purifiers. After same were installed, operation was much improved and troubles in power house greatly reduced. In this power house was also one Diesel oil engine, vertical six cylinder, 25½″x 48″, 4900 H. P., two cycle, air at 1250 and oil at 1050 pounds was constantly maintained on fuel line and fuel valve was mechanically operated to admit fuel and air into cylinders. This particular vaporizing device permitted the use of any grade fuel oil even to road tar and the engine operated fairly well on road tar. Mr. Schwab placed so much confidence in West that he ordered built a boat to be equipped with a single oil engine (not duplicate units as boats usually have.) Name of boat was Cubore, 630 feet long. This ship successfully completed seven trips to Cuba and return. The engine and boat were built in 1917 to 1920 and the engine was shipped from Bethlehem factory made 24 car loads. Engines were equipped with four compressors using air at seven ounces for scavaging of two stroke type and high pressure fuel admission took place during the ignition period of power stroke about the first 40 degrees. Air compounded 0-120 to 440 to 1250 and oil pump pressure to 1050.

Efficiency

In the internal combustion engine combustion takes place directly in the cylinder, that is the mechanical energy is changed into heat energy, which acts in this case as a furnace or boiler. The medium or carrier in the internal combustion engine is formed from the fuel and the air required for combustion. This acts very nearly as a perfect gas, while the action of the steam engine cylinder is

(Continued on page 94.)

Using Activated Bleaching Earths On Acidified Lubricating Oils

By Ismar Ginsberg

LUBRICATING OIL is made from the crude mineral oil through a series of distillation and purification processes. It is common knowledge that the difficulty of the treatment has resided not so much in it being any great task to find materials and chemicals that will remove the ingredients of the original crude oil, in order to obtain a properly refined product to be used as a lubricant, but rather in the fact that the chemicals that are used in the process introduced certain conditions which had later to be overcome in order that the finished product might be available for use as desired.

Thus it is known that there are two main processes to which the crude oil fraction is subjected before a finished lubricant can be obtained. The first is treatment with sulphuric acid of high concentration and the second is bleaching. The mineral oil distillate must first be treated with the acid. Then after the acid has performed its action, it must be completely removed. This is effected with the aid of sodium hydroxide, as far as it is not affected through the bleaching action itself, which will be explained below. Such action has of course a beneficial effect on the economy of the process, saving caustic soda.

The second main process is that of bleaching. It is this process which is the subject of an interesting article, which appeared in Petroleum Zeitschrift, 1926, pages 123ff, and the data in this article has been drawn upon in the writing of this paper.

Two Processes

At the present time there are two principal types of the bleaching process. In one fuller's earth or floridin is used. Both of these substances are natural aluminum-magnesium hydrosilicates. The second process consists in the use of chemically active earths as manufactured by Bayer & Company in Germany. The bleaching field seems to be open to these two processes, for it is a fact that the use of fuller's earth and floridin superseded the old practice of employing ox-blood and animal charcoal.

The activated chemical earths are prepared from a certain type of clay which is treated with mineral acid and hence it follows that there is always a slight trace of the acid present in them. It is of course understandable that the use of substances, which contain acid, in the bleaching process will contribute to the acid content of the lubricating oil, and inasmuch as the neutral earths, floridin and fuller's earth, contain no acid, it follows that they possess an advantage in this respect over the chemically activated bleaching earths. If this contention is substantiated, and if it is a fact that the acidity in the bleach earths is able to cause quite a marked change to take place in the properties of the lubricating oil, then it must be concluded that the use of the activated earths is fraught with disadvantage.

In the aforementioned article there are contained the results of experiments made with the definite purpose of determining just what is the effect of the slight amount of acid present in these chemically activated bleaching earths. Before starting this discussion, it must be mentioned that as far as bleaching power is concerned, the chemically activated bleachers are considerably more active than the natural earths.

Finding a Basis

The first consideration in a research of this sort is to base the argument on some logical foundation. Thus, if any of the acid that is present in the chemical bleach is to be found in the lubricating oil, which is treated with it, it must be evident that this acid must have been carried over from the bleach into the oil. The question now arises how much of this acid can be so transmitted from the acid bleach to the oil. If no such transmission takes place then it follows that the acid content of the oil is no detriment.

To clear up this matter an examination was made of a number of lubricating oils before and after they had been subjected to the bleaching process. The oils that were employed in the experiment had been treated beforehand with sulphuric acid and then neutralized with sodium hydroxide. The acid content of the chemical bleaches was determined in the following manner. Fifty grams of the bleaching earth were admixed to the form of a slime with five hundred grams of boiling hot water, the liquid part of the mixture is sucked off while the latter is still hot, and then the acid content of the filtrate was determined by titration. The duration of the action of the bleaching earths on the petroleum product was thirty minutes, the temperature varied between 95 and 110 degrees C and the amount of earth used on the weight of the lubricating oil was fixed at three to ten per cent.

Results

The results that were obtained from this series of experiments are given in the following tabulation. From it it is evident that various types of lubricating oil were tested and that the results obtained varied.

Kind of lubricating oil—	Acid content of the chemical bleaching earth, figured as grams of HCl.	Acid content of the oil figured in percent SO_3. Before bleaching.	After bleaching.
Spindle oil	0.0179	0.001	0.001
Machine oil	0.0179	0.004	0.004
Machine oil	0.0143	0.003	0.0025
Motor Oil	0.0162	0.003	0.003
Bearing oil	0.0159	0.005	0.005
Machine oil	0.0159	0.009	0.0085
Machine oil	0.0213	0.01	0.01

There is one fact which is at once evident from the above tabulation and that is that the use of chemically-activated bleaching earths, which contain acid has no effect in increasing the acid content of the lubricating oil. It is also a fact that good bleaching earths of this character do not contain any more than 0.036 per cent acidity, figured on HCl.

It is known that the oil is subjected to after-treatment with an alkali after the acid treatment, which is a part of the refining process. It is a fact that the action of floridin and fuller's earth is similar to the action of alkali and hence it is not necessary to subject the lubricating oil to an alkaline treatment when the bleaching is conducted with the aid of these natural earths. The question arises does the chemically-activated earth offer such an advantage.

To determine this a machine oil, 0.9371 specific gravity, was treated with four different kinds of bleaching earths, which varied both in bleaching power and in acid content. The preliminary treatment of the machine oil is carried out with five per cent concentrated sulphuric acid—1.84 specific gravity, and the acid tar is thereafter removed.

Amount Used

The amount of bleaching earth used in the experiments was three per cent, figured on the weight of the lubricating oil; the temperature was 95 degrees C. and the duration of treatment in the first case was ten minutes, in the second case 45 minutes and in the third case three hours. The filtrate was titrated to determine its sulphur trioxide content and the results that were

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obtained from the experiment were tabulated as follows:

Bleaching Earth—	Acid content of bleaching earth figured as Gms. HCl.	Acid content of this machine oil after treatment with the bleaching earth for 10 minutes % SO_3	45 minutes % SO_3	180 minutes % SO_3
1. Floridin	.....	0.003	0.0025	0.0025
2. Fuller's earth	.....	0.005	0.0035	0.0035
3. Chemically activated earth	0.01095	0.023	0.0085	0.008
4. Chemically activated earth	0.0175	0.011	0.009	0.009
5. Chemically activated earth	0.0142	0.009	0.0065	0.006
6. Chemically activated earth	0.009	0.009	0.004	0.0035

The acid content of the machine oil before bleaching was determined to be 0.054 per cent of SO_3.

The above table shows that the acid content of the machine oil decreases rapidly when it is bleached with the aid of floridin or fuller's earth, and on the other hand the decrease in acid content is much slower when chemically-activated bleaching earths are used for this purpose. Nevertheless, the use of the latter earths deacidifiies the oil to a marked degree and in certain cases this action is just as favorable as when the natural earths are employed. The effectiveness of chemically-prepared earth in this respect depends in any case on the intrinsic properties of the earth itself. It was also found that moistened bleaching earths do not have nearly as good a bleaching action as the dry earth.

This is a very interesting fact and was established through the following experiment. A chemically-activated earth with a water content of seventeen per cent was allowed to act for a period of forty-five minutes on oil. The acid content of the earth was found to be 0.0175 gram in equivalent hydrochloric acid. When the bleaching was carried out with three per cent of the earth and at a temperature of 95 degrees C. the acid in the machine oil was reduced from 0.054 per cent to 0.0105 per cent, figured as SO_3. But if this bleaching earth was first dried at a temperature of 110 to 120 degrees C., then when the test was carried out in exactly the same manner as has been indicated above, it was found that an acid content of 0.009 per cent was obtained. On the other hand if it desired to save the time and expense involved in the preliminary drying of the bleaching earth, then the duration of the bleaching must be increased by another thirty minutes, the temperature remaining at 110 degrees C. in order to attain a deacidification equalling 0.009 per cent SO_3.

Phenomena Explained

It must now be clear that the results of the various experiments that have been described above are sufficiently interesting to make it worth while to give a satisfactory explanation of the phenomena. In the first place there is the deacidifying action of the natural bleaching earths, floridin and fuller's earth, for these earths are neutral and do not enter into any chemical reaction. The acid reaction of the bleaching earths gives us an indication of the reason why the two competing bleaching agents act differently, as far as the deacidifying action is concerned. And in this will also be found the real difference between the chemically-activated and the natural bleaching earths, as far as their bleaching action is concerned.

In the first place it is evident that as the artificial earths are prepared with the aid of acids, they must contain traces of this acid. They cannot contain basic compounds and hence it follows that the deacidification of the oil does not and cannot take place as a pure chemical reaction. There remains only the possibility that the acid is removed from the mineral oil by adsorption. If we accept this as true, then we can understand how an "acid" earth can act to reduce the acidity in a lubricating oil. It is a fact that earths, which contain a considerable proportion of acid, can exert this action, as an earth, containing 0.22 per cent acid, as HCl, which cannot be considered as a good bleaching agent, nevertheless is still able to exert a decided deacidifying action.

Adsorption Responsible

If then the deacidifying action of the chemically-activated earths depends on their adsorption of the acid in the oils, then there must be a chemical reaction when the neutral natural earths are employed for this purpose. A test was accordingly made to determine the amount of magnesium carbonate contained in Florida earth and fuller's earth, and this was found to be 6.5 per cent in the former and 1.7 per cent in the latter. On the other hand it is also a fact that certain natural earths do not contain even a trace of carbonates. It was found however that when the chemically activated earths were admixed with a corresponding amount of carbonate, then the deacidifying action of these earths was in excess of that of the natural earths.

One interesting point in this connection is the fact that the chemically-activated earths are able to adsorb considerable quantities of mineral acids from gases. It was also found that there is a connection between the deacidifying powers of the earths and their bleaching power as well. Thus the earths which are the most potent bleaching agents are also the ones that possess the highest degree of deacidification.

In conclusion it may be said that the use of chemically-activated earths do not increase the acid content of the mineral oils that are treated with them. They are able to remove acid from acid-containing lubricating oils. The phenomenon which is responsible for this action is adsorption. Furthermore, the dry bleaching earth is considerably more effective than moist earth. Those earths which possess the highest degree of bleaching power are also the most potent deacidifiers.

Record Gasoline Yield

Bartlesville, Okla.—In the annual report of the Phillips Petroleum Company, natural gasoline production for 1925 was given as 119,852,102 gallons, a daily average of 328,362 gallons.

The Phillips company now has 31 natural gasoline plants, 10 of which were added by purchase and construction in 1925.

Net profits of the Phillips Petroleum Company in 1925 were $12,329,623, or $6.46 a share on the 1,906,936 no par shares outstanding.

Pacific Gasoline Company Re-elects All Directors

All directors of Pacific Gasoline Company were re-elected at the annual meeting of stockholders held February 10, 1926 at the general offices of the company, 700 California Bank Building, Los Angeles.

During the past year the company has increased its production about 26 per cent with the erection of six new plants, the enlargement of two plants and the purchase of two others, making a total of 28 plants now operated by it. The plants which were purchased were those of the Long Beach Gasoline and Refining Company at Long Beach, the transaction having been consummated January 15th of this year.

Directors re-elected for the coming year were Harry J. Bauer, A. N. Kemp, S. M. Kennedy, Fred L. Baker, Kenyon L. Reynolds, Alfred Wright, Alan E. Morphy and H. F. Keenan.

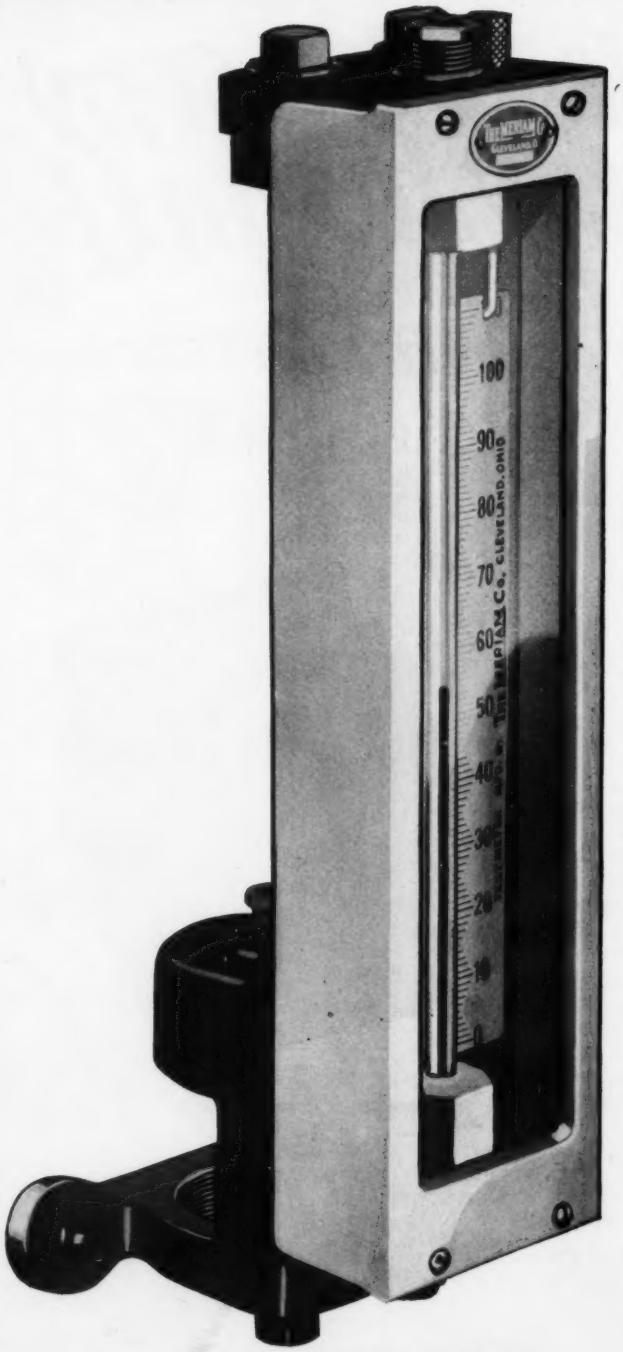
Ozark Plant Operating

Tulsa, Okla. — The Ozark Chemical Company's plant on the Arkansas river in West Tulsa has started operation and sulphuric acid now is being manufactured in quanity for the oil refining trade in the Mid-Continent field. The plant is modern in every respect and is under the management of Park Kelley, an experienced chemical executive.

The company's sales offices have been opened in the Ritz Building here. The plant, machinery, etc., represents an investmen of upwards of $400,000.

Crown-Central Moves Office

Houston, Texas.—Headquarters offices of the Crown-Central Petroleum Corporation and Crown-Central Refining Company at Houston have recently been moved from the Binz Building to the Post-Dispatch Building. Due to the rapid growth of the Crown-Central interests and continuous enlargement of the Houston office force the company has occupied the entire fourteenth floor of the Post-Dispatch Building.



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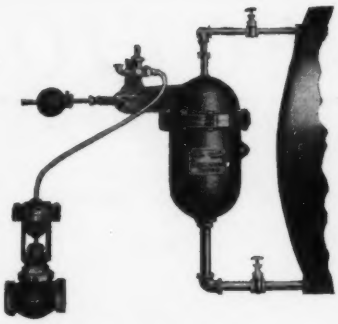

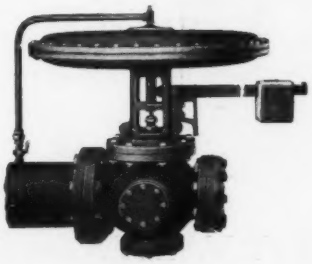

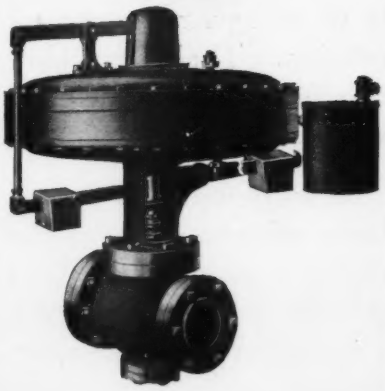

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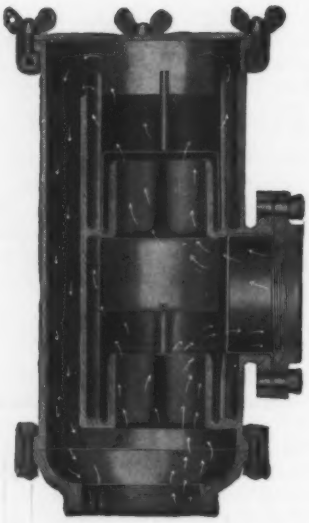

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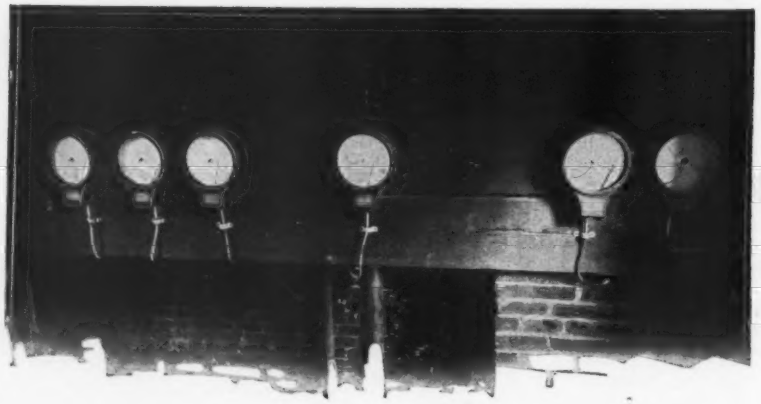

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Proper Design and Operation of Heat Exchangers

By F. L. Kallam, M. E. and A. F. Semino

Production of heat is the most costly single item in petroleum heating. Conservation of heat, once produced, offers opportunity for perhaps the greatest saving in the operation of a refinery or natural gasoline plant.

That is the reason for the development of the heat exchanger in refining circles in the last five years. This development, however, has been haphazard almost as often as it has been scientific.

In this paper Messrs. Kallam and Semino are presenting a treatise on heat conservation in petroleum refining. When completed it will be the most thorough work written on the subject, as restricted to refining.

The series was begun in March and will require three or four issues for completion, after which it will be put in book form.—The Editor.

IT is now in order to consider the several common types of exchangers found in practice with regard to their arrangement and general construction details. From this we may gain some idea how practise follows theory.

Double Pipe—The first type of exchanger, and perhaps the commonest, is the double pipe arrangement. Two types are shown at A, Figure No. 5. They are generally built upon the site where they are to be installed, and hence are always constructed of standard or line pipe, and sometimes of casing. Welding is the method of assembling used, although occasionally some standard pipe fittings are used. The inner tube of such exchangers is rarely less than two inches in diameter, while the shell ranges from three inches up. In order to secure the necessary heating surface, the exchanger must be long, in some cases in excess of 400 feet. In general, however, where there is little space, several shorter exchangers are connected in series. These exchangers are usually carelessly constructed. Often no means are provided for preventing the inner tube from resting upon the inner surface of the larger outer pipe.

There are, of course, installations of this type which embody many refinements of design. Some are built with ammonia fittings, such as are used in refrigerating practice. With this arrangement, expansion of the tube, due to temperature changes, is provided for by packing glands and stuffing boxes. In the case of exchangers of welded construction, no provision is made for expansion, the result of which is badly warped apparatus. The exchanger is not accessible for cleaning or inspecting. Present day practice is to disregard this type of equipment.

Concentric—A development of the double pipe exchanger is the concentric type. Here several standard lengths of pipe are nested or placed one within the other, (B, Fig. No. 5), and so cross-connected that counter-flow is obtained. The cold oil is confined between two layers of hot oil throughout the entire passage through the apparatus. Welded construction is used throughout, and dresser couplings are inserted at various points to allow for expansion. This type of exchanger is not readily accessible for cleaning or repairs.

Multitubular, Own Construction — C, Figure No. 5, shows a typical example of a multitubular type of exchanger. This consists of an outer shell containing two or more tubes within, the latter being either welded, rolled or ferruled into the tube sheets. They may contain any number of passes, though generally they are constructed with one pass in the tubes and one in the shell. In some cases the shell is rectangular in shape, being constructed of welded boiler plates, but common practice is to use large diameter casing. Tubes are either of standard pipe size or of boiler gauge. Expansion of the tubes is provided for where tube ferrules are used. However, in the average case, no provision is made for expansion, even when the tube sheets are some distance apart

In many cases, exchangers such as those described above, are baffled in the shell as shown in D, Figure No. 5, in order to create greater turbulence around the tubes. This is accomplished by spot welding light iron plates, cut to conform to the diameter of the shell, at right angles to the tubes, the number and spacing of the baffles depending upon the allowable pressure drop. Sometimes no baffles are provided, but the tubes are wrapped with heavy wire, wound in a helix.

Various numbers of passes are obtained in the shell by the use of longitudinal baffles, which are fastened parallel to the tubes, and whose outer edges fit snugly against the shell. This sealing off is often accomplished by welding two light iron strips to the inner wall of the shell, so spaced that a groove is formed wide enough to allow the edges of the baffle to slip in between. One such groove is formed on each side of the shell, providing a keyway for the baffle. A thin piece of wood is first placed in the grooves and the baffle then slipped into place. The wooden strips absorb oil and expand, thus effectively forming a tight joint.

Such exchangers are usually built with removable heads, so that the tubes may be inspected and cleaned. Seldom, however, are they so constructed that the entire tube bundle can be removed from the shell. Apparatus of this type is generally built in the shop, so that very satisfactory results are obtained.

Multitubular, Manufactured—The next type of exchanger widely used is that manufactured by makers of heat transfer equipment. One very common type is shown in E, Figure No. 5. The body, channels and nozzles are of cast iron, with all connecting surfaces machined and finished. The heating element in this type consists of small tubes of brass composition, which are never more than ¾ inch in diameter. Because of the many passes through the exchanger, the apparatus is short in length but large in diameter. The fact that the inlet and outlet nozzles are at the same end of the exchanger, facilitates connecting several units together.

The tube sheets, into which the tubes are rolled, are of composition metal, one being stationary, while the other is movable. The free end, often referred to as

NOMENCLATURE

A =Mean effective transfer area—Square feet.
c =Specific heat of fluid—B.t.u. per pound per °F.
c_T =Specific heat of hot fluid—B.t.u. per pound per °F.
c_t =Specific heat of cold fluid—B.t.u. per pound per °F.
C =Coefficient of fluid friction loss depending upon W, D_1 and U.
D_1 =Internal diameter of tube—Inches.
D_2 =Shape factor—Inches.
d =Density of fluid—Pounds per cubic foot.
E =Efficiency of heat transfer—Per cent.
F =Crtical velocity factor depending upon V_s, D_1, S and U.
$J = \frac{W_T c_T}{W_t c_t}$ or $\frac{W_t c_t}{W_T c_T}$ (whichever is less than 1.)
k =Overall coefficient of conductivity.
k_c =Coefficient of conductivity of internal liquid film.
k_H =Coefficient of conductivity of external liquid film.
k_T =Coefficient of conductivity of metallic tube wall.
K =Overall heat transfer coefficient—B.t.u./Hr./Sq. ft./°F.

(Continued on next page.)

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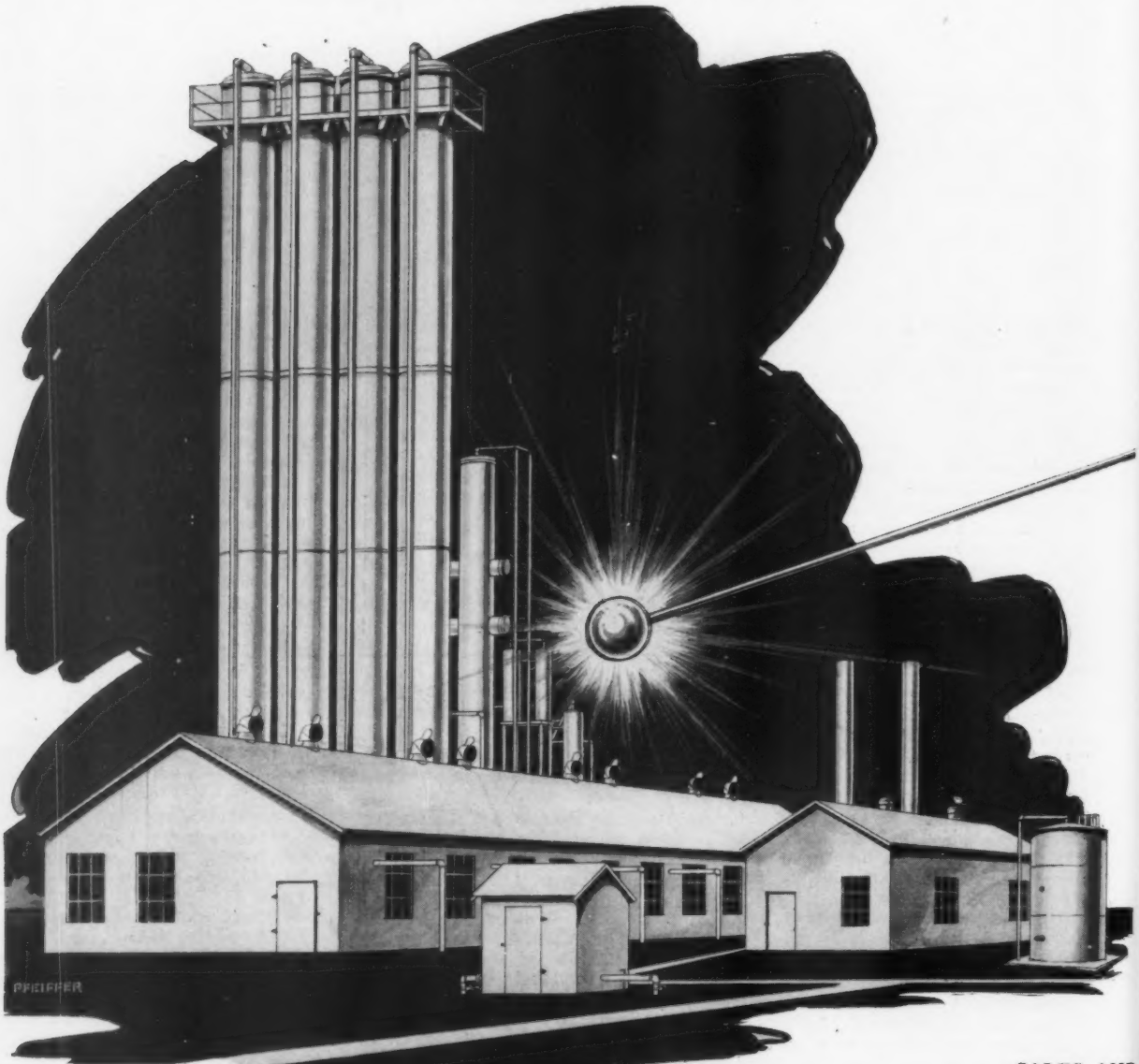

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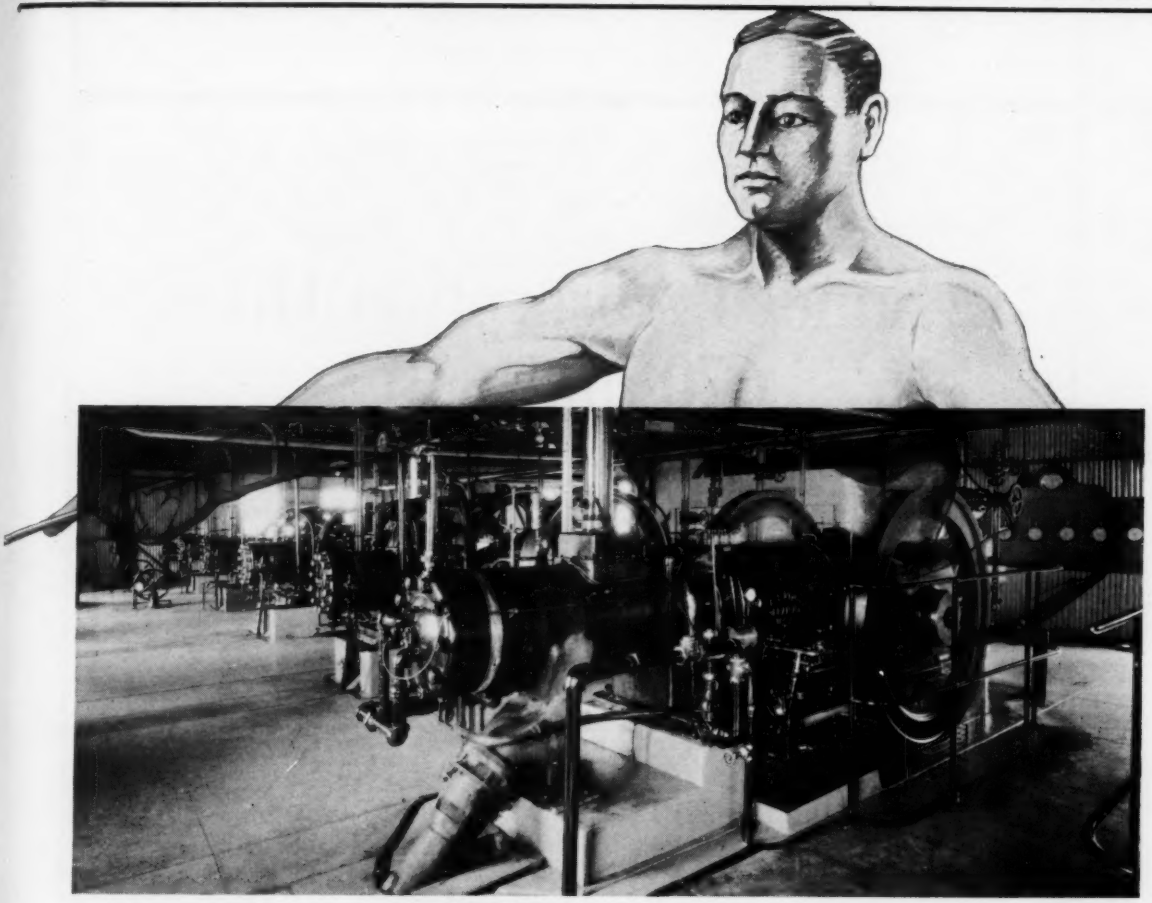

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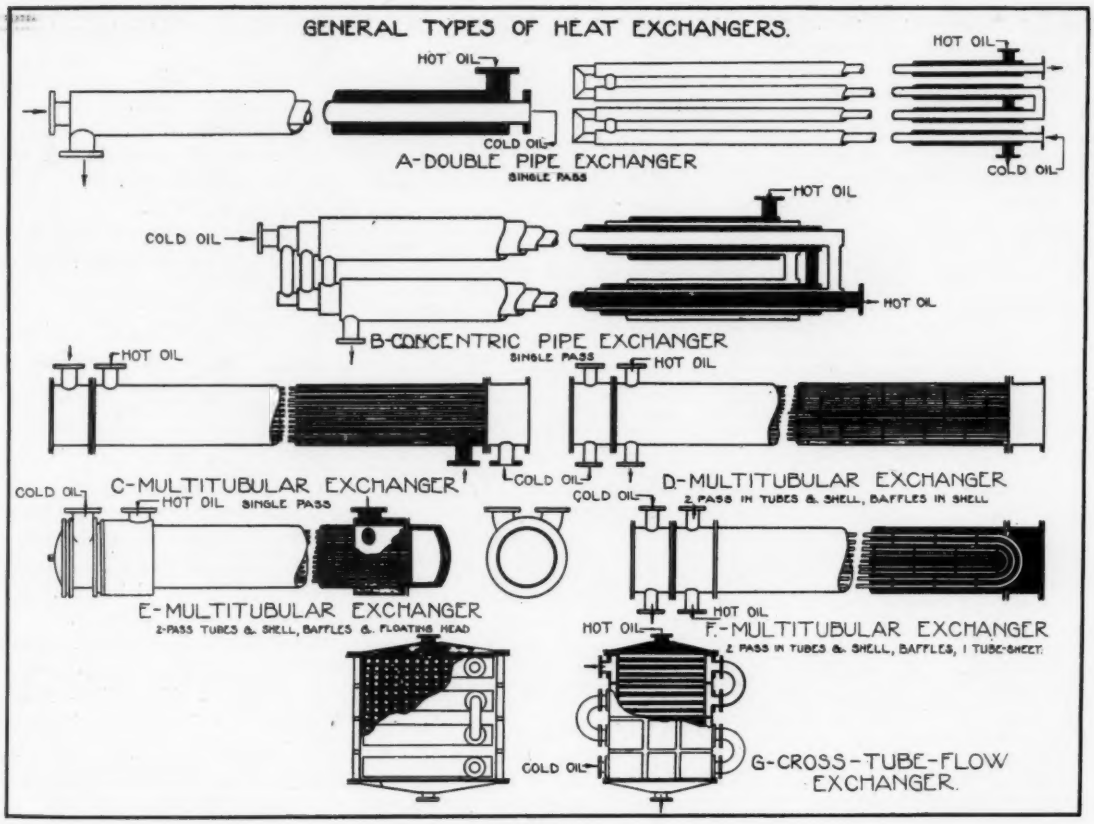

FIG. 5.

a floating head, takes care of the linear expansion of the tubes.

Baffles in the shell are used, varying in shape and form with the different makers, although the basic idea is the same in all cases. Where a number of passes are made in the shell, the mean temperature of the oil changes with each pass, and hence the longitudinal baffle will have two different temperatures on opposite sides. The heat from the hot side will naturally tend to flow to the cold side, instead of passing through the tube surface into the oil flowing within the tube. To prevent this taking place, the baffle is insulated by using two plates placed an inch apart, which space fills with a stagnant layer of oil. This furnishes a baffle far superior to an ordinary single plate type.

Another important feature of this type of exchanger is the removable tube bundle, which gives easy access to both the outside and inside of the tubes.

A second manufactured type is that shown in F, Figure No. 5. This exchanger is similar to the one above described, except that only one tube sheet is used. Here the tubes are bent into a U, the ends of which are rolled into the same tube sheet. Consequently the shape of the tubes allows for any linear expansion due to temperature. The tube element is readily removable from the shell for cleaning or inspecting. The advantage of this type is the elimination of half the number of tube joints; the disadvantage is greater difficulty in cleaning the interior of the tubes.

A third manufactured exchanger is the cross-flow type, one section of which is shown in G, Figure No. 5. The shell in this case may be of either cast semi-steel or of welded construction. In this type of apparatus, the tube sheet is cast integral with the body, or welded to the shell. The ¾-inch Admiraly metal tubes are rolled into the sheets. Inasmuch as the tubes are only 30 inches long, the linear expansion due to temperature is negligible.

In all types heretofore discussed, the flow in the tubes and the shell, while being counter-flow, has been parallel to the tubes. In this type, the oil in the shell flows at right angles to the tubes. Hence considerable turbulence is effected by this arrangement. In this type of exchanger, the incoming cooling oil first comes in contact with the outgoing heating oil, so

L =Thickness of fluid film—Feet.
M =Hourly equipment charge per B.t.u.—Dollars.
N =Cost of recovering one B.t.u.—Dollars.
O =Time—Hours.
P =Pressure drop through pipe—Pounds/Sq. in. per foot of length.
q =Total heat transferred from body of hot oil to body of cold oil.
q_c =Total heat transferred through film on inside of tube.
q_H =Total heat transferred through film on outside of tube.
q_T =Total heat transferred through metal tube wall.
Q =Total heat transferred in heat exchanger—B.t.u./Hr./Sq. ft./°F.
R =Total resistance to flow of heat=$R_c+R_H+R_T$.
R_c =Internal liquid film resistance to flow of heat.
R_H =External liquid film resistance to flow of heat.
R_T =Metallic resistance to flow of heat.
s =Viscosity—Saybolt Seconds.
S =Specific gravity of fluid—Water=1.
t_1 =Temperature of fat (cold) oil entering—°F.
t_2 =Temperature of fat (cold) oil leaving—°F.
T_1 =Temperature of lean (hot) oil entering—°F.
T_2 =Temperature of lean (hot) oil leaving—°F.
T_a =Temperature of body of hot oil.
T_b =Temperature of film of hot oil at tube surface.
T_c =Temperature of film of cold oil at tube surface.
T_d =Temperature of body of cold oil.
Ø =Logarithmic mean temperature difference (M.T.D.)—°F.
U =Absolute viscosity of fluid—Poises.
V =Velocity of fluid—Feet per minute.
V_c =Critical velocity of flow—Feet per second.
V_s =Velocity of fluid inside of tube—Feet per second.
W =Weight of fluid flowing inside tube—Pounds per second.
W_t =Weight of cold fluid—Pounds per hour.
W_T =Weight of hot fluid—Pounds per hour.
X =Value of one recovered B.t.u.—Dollars.
Y =Hourly profit from heat exchanger—Dollars.
Z =Kinematic viscosity of fluid—Poises.

that some counter-flow is encountered. The staggered arrangement of the tubes produces turbulence in the oil flowing on the outside of the tubes.

It is the usual plan to have from five to twenty passes through the tubes to each section, this being accomplished by bolted on bonnets. The tubes can be exposed for cleaning by removing the bonnets, but the tube element can not be withdrawn from the shell. However, it is possible to clean the exterior of the tubes through the large nozzles in the ends of the shell.

General Method of Heat Transfer Solution

The theories of heat transfer have been set forth in full in the preceding pages. It is now in order to explain the method selected for correlating the experimental data. The controlling physical characteristics of the fluids as mentioned before are:—

U=Viscosity.

d=Density.

c=Specific Heat.

k=Thermal Conductivity.

The combination of these characteristics with the dimensional constants of the heat transfer surface and the fluid velocities (V) constitutes the analysis.

The experimental data can be graphically represented by plotting on logarithmic cross-section paper, the factors $K\,D_1/D_3$ versus $D_1D_3V_1V_3d_1d_3/U_1U_3$. It has been found that these factors follow an approximate straight line relation on logarithmic paper. The prediction of the performance of similar apparatus is therefore greatly simplified.

The method selected was decided upon after a thorough analysis of all the logical combination. The conductivity factor has not been included for the reason that no accurate data are available on the oils concerned. Investigators have found that the conductivity of petroleum oil is approximately constant for all grades, so that the elimination of this factor from consideration will have no serious bearing on the final results. Furthermore, the conductivity varies very little with change in temperature, so that it can be assumed to remain constant for the range found in practice.

The transfer coefficient K being the overall, it is logical to introduce in the analysis, a factor to care for the thickness of the oil flowing on the outside of the tubes. This is taken care of by D_3, which may be referred to as the "shape factor", because it depends upon the arrangement and dimensions of the transfer surface. The ratio of length to diameter has not been considered because the available data show no perceptible difference. The reason for this may be due to the compensating effect of the coefficient K and the mean temperature difference.

Data to Be Secured and Used

The data required for analyzing the performance of an oil-to-oil heat exchanger may be grouped as follows:—

Construction Details—

(1) Diameter of tubes, internal and external.

(2) Length of tubes.

(3) Spacing of tubes.

(4) Number of tubes.

(5) Number of passes through tubes.

(6) Diameter of shell.

(7) Length of shell.

(8) Number of passes through shell.

(9) Baffles or turbulent plates, type, number, size, etc.

Experimental Data—

(1) Quantity of lean oil flowing.

(2) Quantity of fat oil flowing.

(3) Gravity of lean oil.

(4) Gravity of fat oil.

(5) Viscosity of lean oil.

(6) Viscosity of fat oil.

(7) Temperature of lean oil entering.

(8) Temperature of lean oil leaving.

(9) Temperature of fat oil entering.

(10) Temperature of fat oil leaving.

(11) Specific heat of lean oil.

(12) Specific heat of fat oil.

(13) Pressure drop through tubes.

(14) Pressure drop through shell.

It is well at this time to define the meaning of a number of terms given above. The term "tubes" refers to small tubes or pipes which make up a heat exchanger, while the "shell" is the container

(Continued on page 95.)

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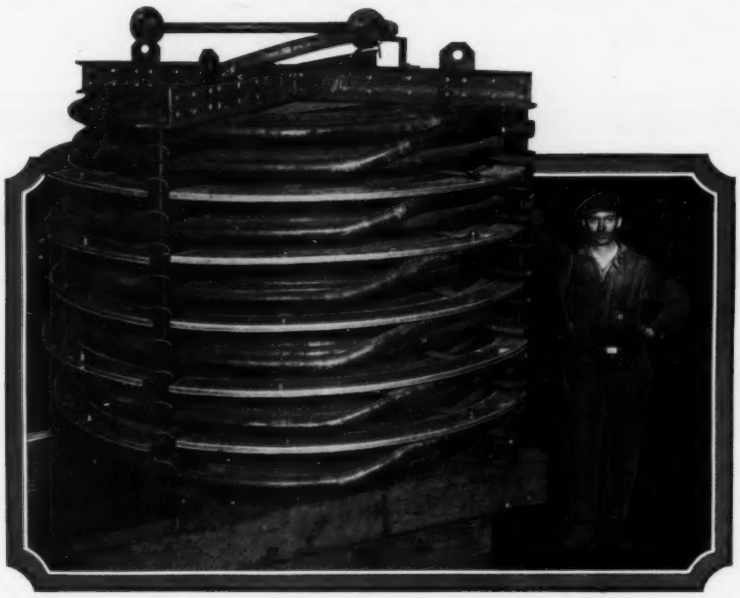

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Chemists Stress Petroleum Subjects At Tulsa Meeting

By Roye Munsell
Staff Representative

Tulsa, Oklahoma.—The most comprehensive collection of technical papers dealing with petroleum and its products ever assembled was a part of the program of the 75th meeting of the American Chemical Society held here April 5, 6, 7, 8, and 9. Petroleum and its products were particularly stressed because of this first meeting in the oil country.

Altogether 44 papers dealing with either the nature, use or refining of petroleum oils were presented before the several sessions of the Petroleum and the Engineering Chemistry divisions. A part of these went to make up a most comprehensive symposium of lubrication.

The papers and the discussions which accompanied them gave much evidence of the growing interest of chemists in fundamental petroleum research. Chemists and other technical men are apparently realizing the patent necessity for scientific study of petroleum.

Place of Chemistry

Many important advances have been made in the comparatively short history of the industry. Most of these have been from the standpoint of the commercial and engineering arts, however. Actual chemistry has been much neglected. And this is because the industry has depended very largely upon experimentation of one sort or another. The cracking process is the noteworthy contribution of chemistry to the industry.

At the meeting new uses for petroleum were described and forecast. The recognition of the potentiality of petroleum as a raw material was an important development of the meet.

Future advances in the technique of the industry ought not only see some present products greatly bettered, but new ones of a higher utilization, now little known, or even unknown, made available.

Dr. Arthur D. Little of A. D. Little, Inc., speaking on the subject, "The Romance of Carbon," said in this connection:

"A new phase of great significance is now confronting the industry, for petroleum is about to take its place as a raw material of first importance in the synthesis of organic chemical compounds."

The production of such a product as synthetic rubber from petroleum is by no means a far-fetched possibility. Dr. Little told of experiments by his organization wherein isoprenes have been obtained from mineral oils. From that point a synthetic rubber is not such a far step as one might suppose.

Source of Alcohols

Petroleum is already a known source of numerous alcohols and their derivatives. Commercial alcohols, especially those used as solvents, may be produced almost entirely in the future from crude oil. Drugs, chemicals, dyes and other derivatives will under the necessary circumstances probably be manufactured from petroleum on a commercial scale, displacing present limited sources.

Among the common products which one may expect to see made from petroleum, or bettered thereby, are soaps, oils for cooking and other purposes, and improved engine fuels, to mention a few. The production of alcohols from mineral oil is already being accomplished on a small scale.

Samples of Aliphatic Tertiary alcohols made from petroleum were shown to the members of the American Chemical Society. The nature and industrial possibilities of these rather unfamiliar alcohols was the subject of a paper prepared for the meeting by Harold S. Davis and Wallace J. Murry.

New Process

A new process of recovering products from crude oil discussed by the Petroleum Division was that employing solvents. It was announced by Harold M. Smith of the U. S. Bureau of Mines. The method proposed is the result of experimental work carried on by the Bureau.

The process by which solvents are used to separate several constituents from crude oil was described as continuous and much simpler than that used in distillation.

Cracking and the characteristics of cracked products occupied a large part of the program. A paper by E. H. Pothoff and E. H. Leslie on the effect of some independent variables on the cracking of petroleum oils was an interesting contribution.

It was found by the authors that pressure is of much less effect in the cracking process than the time element. When pressure was quickly added from an outside source no material change was had in the quantity of gasoline obtained. Pressure increases were found most effective when extended over a period of time. When the temperature variable was studied, it was found that increases in temperature resulted in material increases in gasoline production.

The data presented was the result of tests made on reduced crude, straight run gas oil and Dubb's residuum.

Cracking Shale Oils

Gustav Egloff of the Universal Oil Products Company, Chicago, told of results of cracking shale oils for motor fuels which are of not a little economic interest. He reported that at least half of the oil obtainable from shale could be converted into good gasoline.

Oil shale deposits, he estimated, approximated 394 billion tons, enough to supply motor fuels for 150 years after present rock oil reserves are depleted.

Although the government has abandoned color specifications for U. S. Motor gasoline, the chemists dealt with the subject quite extensively.

A paper by James B. Withrow and Albert H. Villbrant reported the interesting case of a jobber who after placing about 75 cars of good gasoline in storage found on removing some that it had changed to a quite yellow color. On exposure to sunlight, however, it soon returned to its one-time white color. Another lot of gasoline which had come from the stills with a yellow color was not affected by the action of sunlight.

Other chemists told of similar findings. Against these might be mentioned the experiences of some in having gasoline go off color in visible pumps.

Acidity rather than oxidation as the cause of discoloration was the conclusion of a paper by Benjamin T. Brooks. He reported that a very small amounts of acids caused pronounced discoloration.

Dr. Brooks said in connection with the subject of gum formation that it has yet to be proven that di-olefins are responsible. Gum, he held, is a mixture of peroxides, kelonis, aldehydes and oragnic acids.

The A. C. S. at its Tulsa Spring meeting approved of plans for a Fall meeting to be held at Philadelphia the week of September 6, during the sesqui-centennial exposition there. At that time the society will celebrate the 50th anniversary of its organization.

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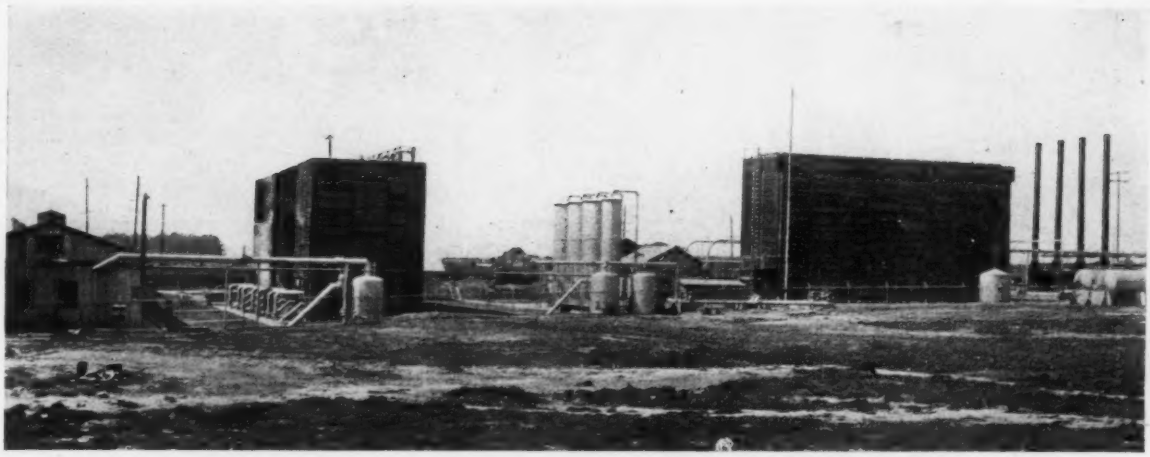


Figure 1. View of plant No. 6 of the California Gasoline Corporation at Long Beach, California

Standardization Sought in California Gasoline Corporation Plants

By George W. H. Reid

THE recently completed absorption gasoline plant of the California Gasoline Corporation is the sixth installation for this company since its organization three years ago, and though the plant is essentially a duplicate of the five installations preceding it, certain features and methods are found incorporated in the design and construction which are of much interest.

During a recent visit including all of the plants mentioned above, many features of interest, as well as features denoting efficiency of design, control, and operation were noticeable. The company treats the natural gas produced from the Long Beach or Signal Hill field, in four of its plants. Plant No. 6, which is treating natural gas derived from the Northwest extension of the Long Beach field, will be described at this writing. One of the most striking conditions, however, existing with each plant visited is that of spotless cleanliness. The plants are bright in their appearance, the color scheme being that of aluminum coating for all absorbing towers, scrubbers and other structural work, with white prevailing as the color of evaporators, preheaters, exchangers, etc. Boiler settings are of brick and colored red. The yards are free of clutter and oil darkened areas, and building interiors boast of spotless floors and walls—well lighted and ventilated.

Standardization Sought

Another interesting feature prevalent is the decided tendency, if not to say accomplishment, toward standardization of all equipment and working parts. Size and dimensions of compressors, evaporators, preheaters, absorption towers, pumps, exchangers and boilers, are standardized to the point of instant interchangeability. Control instruments, gauges, even valves and similar items are each of a uniform type or brand.

The advantages secured by operating a number of plants along such lines, are obvious. If for no other advantage than the stocking of spare parts for replacement purposes, the gain in time and money saving is large. The usual heterogeneous or conglomerate collection of hundreds of parts in the company stockroom, for, possibly, as many different types, brands, and models of necessary equipment, is eliminated, and the investment in such equipment for replacement, along with the labor of handling, warehousing, etc., is greatly reduced. Along these lines it has been the policy of the company to experiment with certain items of equipment until the type required was thoroughly tested and found satisfactory to their own peculiar needs, and then to standardize upon that equipment throughout all of their operations and installations.

Plant Description

Figure 1—illustrates the installation of plant No. 6. In the construction of this plant the company has designed and installed with the idea of future enlargement in mind, and all equipment in both the compressor plant and the absorption plant has been so arranged and laid out that equipment can be installed to double the present capacity at any time without seriously interfering with the operation of the first unit.

The compressor plant, or booster, is constructed adjacent to the absorption

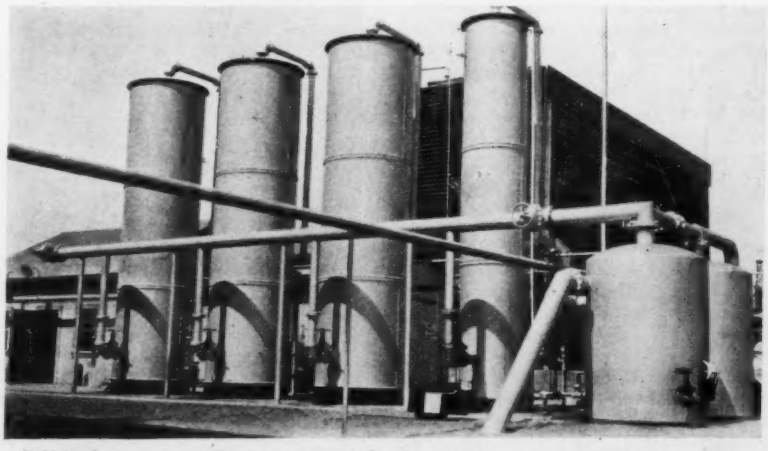


Figure 2. Installation of four absorbers and scrubbers at absorption gasoline plant

Figure 3. View of absorption plant showing heat exchangers at right. Gasoline storage tanks at left

equipment and the gas is handled here by seven 165 horse power direct connected Clark Engines—compressor size 16-inch by 17-inch by 20-inch. The machines gather the natural gas at no vacuum at the well, delivering it to the absorption plant at about 35 pounds pressure.

The incoming gas is conducted through a large cylindrical scrubber, entering at the side and whirling around the circumference of the scrubber, then to pass through several layers of fine mesh screening which is tightly wrapped around the outlet nipple, extending well into the scrubber at the center. In this plant the gas is scrubbed centrifugally three times. Once before compression, one again before entering the absorption towers, and the dry gas leaving the absorbers passes through the third scrubber before entering the residue gas lines, where any entrained absorption oil is thrown out.

Absorption Equipment

Leaving the compression plant, cooled and scrubbed, the gas then enters the absorption apparatus. The operation cycle here is similar to the ordinary absorption gasoline plant, but such features as compactness of construction, simplicity of design, and the practically automatic control of the entire operation are indicated at a glance, There are four absorbers of the "Oil Froth" type, three of which are six feet by 25 feet, and one tower 4 feet by 25 feet, in dimensions. A header line carries the gas to all four absorbers, block valves on the lead in lines being used to control the volume of gas entering each tower. Manometers are installed on each gas intake line which act as indicators of the volume of gas passing into the towers. In addition, as a feature of absorber tower control, the cool lean absorption oil is metered into each tower separately—thus assuring that each absorber is supplied with the correct required volume of gas and absorption oil. The flow is counter-current in the absorber, through devices peculiar to "Oil Froth" absorber construction. Figure No. 2--shows absorbers and 2 scrubbers as described.

The residue, or lean gas leaving the top of the absorbers is conducted through short outlet lines into a header line, then through the third scrubber as mentioned before and out through four lean gas lines to the various points about the field. On each of these lines a recording meter is installed—all four recorders being inclosed in one easily accessible box-like house.

The enriched or "fat" absorption oil is handled by a Worthington pump, 10 inches by 7 inches by 10 inches—which discharges the oil into the heat exchangers. These exchangers are constructed for the most part of standard fittings and steel pipe, 60 feet in length, designed on the counter-current flow principle, the hot oil from the still of evaporator, and the cool oil from the absorbers making a total of 8 passes—or 480 lineal feet of exchanger surface. Figure 3 illustrates the exchanger installation on the right of the photograph, showing their position in relation to the remainder of the plant. The exchangers have a rated capacity of 16,000 gallons of oil per hour—heating the cool, "fat" oil from about 80 deg. F. to 240 deg. F., and cooling the lean oil from the still from about 295 deg. F. to about 140 deg. F.

Heating Equipment

Leaving the exchangers the partially heated "fat" oil is conducted to the preheater. In the preheater the oil is further raised in temperature to about 305 deg. F., by live steam. The heater is of the pipe coil type with a surrounding shell for the steam, horizontal, and lays parallel to the evaporator, or still. The evaporator functions to separate the gasoline vapors from the lot enriched oil. Figure 4 illustrates the evaporator or distillation apparatus installation. The evaporator is of the horizontal baffled type, and the oil entering and leaving this device is kept in constant and violent agitation by the exhaust steam from the oil and water circulating pumps, all of which steam is used.

Following the vapors through the vapor line they enter the dephlegmator, which is installed and constructed on the top of the cooling tower. The dephlegmator is so designed that the cooling is effected by the evaporation of water, all of the heat extracted being thus dissipated into the atmosphere. This practice differs from the usual method of cooling in an exchanger type of apparatus, using oil or water as a circulating cooling medium. In the dephlegmator, all of the gasoline vapors, and steam used for agitation are separated along with any heavy entrained absorption oil. The water and heavy oil thus condensed are returned to a separating tank, the oil rising to the top to be returned to the evaporator, while the water, being controlled by a liquid level control device is automatically blown out at intervals to a tank where it is reclaimed. The gasoline vapors leaving the dephlegmator are condensed in welded coils, open type, which are sprayed from above with cool water.

Tankage

The gasoline tanks are constructed of heavy material, and around the storage

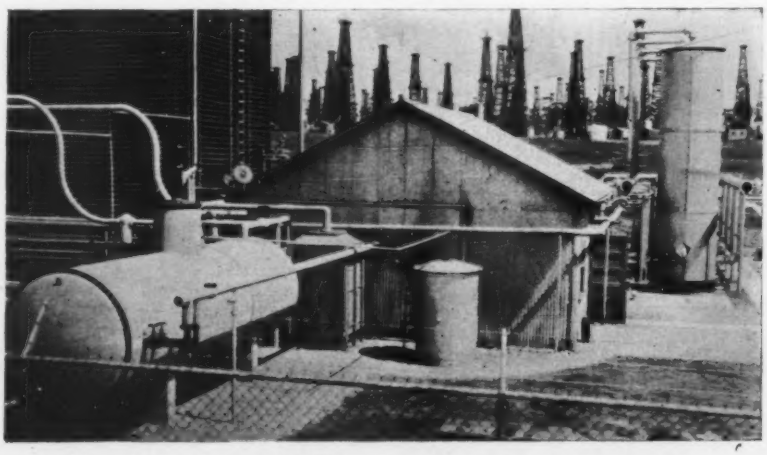


Figure 4. Showing central location of control or pump house, evaporators, absorbers, etc., surrounding it.

Tube stills and Tube cleaners

Tubes in oil stills, like any other tubes through which a heat transfer is effected, must be clean if efficient operation is desired.

Refineries have found it necessary to clean tubes after every run.

For this work a cleaner is needed which will clean the tubes rapidly and thoroughly, and stand up under the severe operating conditions encountered in removing the hard, coke-like scale which forms in most still tubes.

We have worked right along with the oil refineries in developing cleaners, not only for the different types of stills, but for the various other tubes and pipes encountered in refinery work. Lagonda Cleaners may be equipped with long surface cutting heads, drills, brushes—both head and motor to fit exactly the particular service.

Our men are experienced in refinery work and are glad to pass on to you the benefit of this experience.

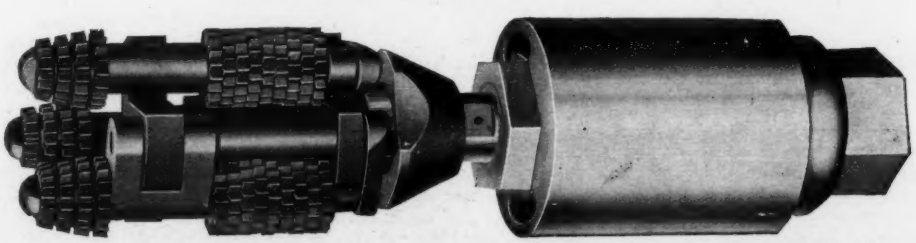
The Lagonda Mfg. Co.
SPRINGFIELD, OHIO

NEW YORK, CHICAGO, PHILADELPHIA, BOSTON, PITTSBURGH, CLEVELAND CINCINNATI, DETROIT, SYRACUSE, BALTIMORE

FUEL SAVING SPECIALISTS

ST. LOUIS, KANSAS CITY, DENVER, DALLAS, ATLANTA, SAN FRANCISCO, MONTREAL, LONDON.

Makers of Lagonda Boiler Tube and Condenser Cleaners, Tube Cutters, Cap and Header Reseating Machines, etc.



X-1402

Lagonda Air Driven Cleaner for 3-inch I. D. tubes in cracking still furnace, equipped with long surface Quick Repair Head.

Mention Where You Saw the Advertisement

tanks the company has constructed a concrete fire wall four feet high for fire protection.

The lean oil from the still or evaporator is circulated through the exchangers, where it is reduced in temperature to about 140 deg. F.; then further cooled in coils to about 70 deg. F., before it is returned to the absorbers for enriching and recycling. This work is also performed by a Worthington pump, size 10 inches by 7 inches by 10 inches.

The waters is circulated by steam pumps of the same type and make—9 inches by 8½ inches by 10 inches. Three pumps for each cycle, water and oil, are installed, leaving one auxiliary pump ready at all times for instant use. The pump house and control room, being one, is located in the center of the installation, and the recording instruments of temperature and pressure are all installed in this central location. The plant operator is at all times cognizant of conditions throughout the entire installation, and due to his central post is never more than a few steps distant from any working part of the plant.

As an item of interest along the lines of Safety it is noted that the four 70 horse power return tubular boilers furnishing steam for the preheater, oil and water pumps, and compressor plant circulating pumps, are located upon the highest point of the company's property and as distant from the plant proper as size of the location will permit.

Another item of interest is the installation of quick opening valves on the water drain lines on all gasoline tanks. It was pointed out that since the operator must hold the quick opening valve open by hand, he must of necessity stay with the tank until the water is drained off—instead of opening his valve in the usual way and often going off to some other task to forget the open valve and the probable wasting gasoline.

The plant, as described, has a rated capacity of 10,000 gallons of gasoline daily, and though it is newly finished and has been in operation but a short time, it is operating smoothly and with the efficiency required by the constructing organization.

Number 6—The Residue Circuit

By Otto Peters
Hanlon Gasoline Company

This is the last of the series, which Otto Peters has adopted as his idea of the six circuits of the natural gasoline plant.

This series has been valuable chiefly in that it has offered a method for studying a gasoline plant. Each day men are coming to work in gasoline plants for their first time. For such men the chief need is study.

Those fortunate enough to follow this series of articles have had a basis for study. It has been only a basis, for each man must make his own study. Anything put in a publication can but point the way.

This publication has been glad to print something that can be used in this manner.

—The Editor.

WE study this circuit from the high stage accumulator tank to the residue supply manifold piping.

In the compression plant the gas from the high stage accumulator tank furnishes the residue supply so that this residue gas then is taken from the high stage accumulator tank by means of pressure reducing devices. One method is by means of an expansion valve, another would be by a series of pressure regulators of the diaphragm type, one of which would be a high pressure regulator with a small diaphragm reducing the pressure from about 250 pounds to 50 pounds, the other a low pressure regulator with a large diaphragm which reduces the pressure from about 50 pounds to pressure desired on supply manifold to which would be connected the different residue supply lines. In practice we find that these pressure reducing devices need careful attention, you understand of course that they affect the pressure of the high stage compression one way or the other. We find that on the gas header to the engines it is best practice to maintain a pressure in ounces so that on this header a regulator is needed which reduces the gas pressure from pounds pressure to ounces pressure. The troubles to which these devices are subject are many, keep in mind that they are of utmost importance because if they fail to operate a hazard is brought about which may be disastrous.

The G. P. M. yield of the residue gas reflects the efficiency of plant operation, and in the operation of the compression type of plant many practices prevail, such as blending in the cooling coils, blending in the storage tanks, and blending in the tank cars. All efforts are made not only to increase production, but also to save what is made. In some cases the residue gas is passed through naphtha storage, in others the absorption system is applied to the residue gas. This residue gas is quite a study, if we assume that at ordinary temperatures Methane and Ethane are gases which carry along the Propane, Butane, Pentane, Hexane and Heptane constitutents, it will be interesting to find out what you have left in the residue, particularly interesting why, but as told you in circuit No. 5, be careful of the distillation you may make. It is good practice to test it for air content, and where the gas engine is designed to operate on so many B. T. Units it may interest you to check up on it. If you live at the plant I don't mind telling you a secret, my wife's cook stove keeps me well posted, let there be a little too much air, too much heat, and I am out of luck with the wife.

Some contractural agreements call for residue gas to be returned to the lease from which the raw gas is taken. We have in mind that the residue gas is used as fuel for plant operation and the operation of lease equipment, but the big idea in handling this gas is, it's the last chance we operators have at it to make a showing in conserving the interests of the plant we operate, of course the gas is metered, the thing to do is make every cubic foot count, in circuit No. 1 you bought the gas, in this circuit No. 6 you sell it, keep in mind a leak costs money. Much forethought can be shown in conserving the residue supply. Improper adjustment of air valve on engine, needless engines operated, faulty gas burners on boilers, leaky lines, needless fires, all these things effect residue supply and many times whole leases have been shut down in winter due to failure of residue supply from the plant. It is just as necessary to watch over this circuit as we do over circuit No. 1, perhaps more so, because the time is coming when residue gas will be subject to more varied uses than it is at the present, and in the last analysis residue gas in our practice means money.

Now that we have gone through what I call six circuits of the compression plant, and it has been my pleasure to submit these six articles for your consideration, there are some things of which I am not unmindful. The generosity of my company permitting me to impart this practical knowledge, the courtesy of the editor in devoting valuable space for what may be considered old stuff, and the reader to whom I can only say they were written in a spirit to pave the way for analysis of present day practice, combining compression and absorption, and I feel sure you agree there is much to learn in the operation of a gasoline plant, and one other thing, as I drew up these papers I realized more fully the kindness, the patience, the teaching of the men I worked under while learning this business of gasoline plant operation, and I close my last paper on the compression plant happy in the thought they may have helped some one.

Refinery Oil FITTINGS

Meet the needs of Refineries and the Oil Fields.

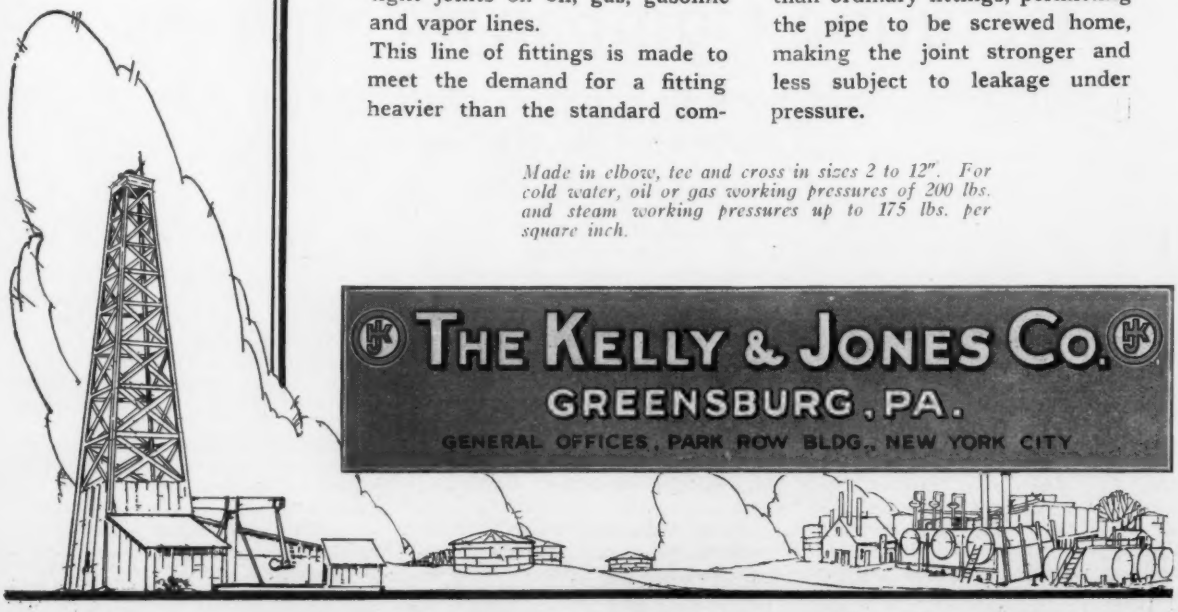
Makers of

Power Plant Piping.
Wrought Iron Pipe and Nipples.
Cast Iron Fittings, Screwed.
Cast Iron Drainage Fittings.
Cast Iron Sprinkler Fittings.
Cast Iron Fittings, High Pressure.
Casing Fittings.
Malleable Iron Fittings.
Cast Iron Flanged Fittings.
Cast Steel Fittings.
Brass Fittings.
Brass Valves & Cocks.
Iron Body Valves & Cocks.
Cast Steel Valves.
Ammonia Valves and Fittings.
Expansion Joints.
Engine & Boiler Fittings.

Specially designed fittings for a special and exacting class of service. All these fittings have long thread lengths and make possible tight joints on oil, gas, gasoline and vapor lines.

This line of fittings is made to meet the demand for a fitting heavier than the standard commercial standard malleable, but not so heavy as an extra heavy fitting. These refinery fittings are also longer, center to face, than ordinary fittings, permitting the pipe to be screwed home, making the joint stronger and less subject to leakage under pressure.

Made in elbow, tee and cross in sizes 2 to 12". For cold water, oil or gas working pressures of 200 lbs. and steam working pressures up to 175 lbs. per square inch.



THE KELLY & JONES CO.
GREENSBURG, PA.
GENERAL OFFICES, PARK ROW BLDG., NEW YORK CITY

Aerial view of the Indian Refining Company's Lawrenceville, Ill., plant. The company's new office building is shown in the upper center.

Centralization Contributes to Indian Refining Company's Success

More from New York puts offices with refining plant at Lawrenceville, Indiana

By Keith J. Franshier

THE Indian Refining Company is a splendid example of the strong isolated, growing and progressive refining organization. Situated at Lawrenceville, Ill., and attached to no particular group of refineries, the Indian Refining Company is peculiarly individualistic.

Perhaps this factor of location lends impressiveness to the success which has been attendant upon this company's efforts. It is always the solitary thing, the thing apart, which is of outstanding attraction, even when its achievement may not surpass that of any single member in a group. But when, as in this case, this factor of standing alone from both geographical and economic standpoints is emphasized by remarkable success attained in management and operation, the challenge thrown out to the attention is clear and unmistakable.

No one can look at the Indian organization even casually without being impressed by the "on-the-ground" characteristic of the management of the company. That is to say, that this is a company controlled and operated on the spot. Concerning this fact is one of the most interesting features of modern business practice, whether in oil refining or in any other business. It will be related presently.

Rebuilding Plant

One of the remarkable things about the Indian Refining Company is the extent of its enlargement and expansion program. Millions of dollars are being spent in what will be a complete metamorphosis.

"We are literally junking a 10,000-barrel skimming plant," says Colonel James H. Graham, president. This is true. It is being accomplished as a part of a modernization program which is very extensive and which entails numerous unique features in refinery practice and construction.

Something of what this program involves may be understood from the comparison of gasoline recovery from the crude by skimming plant with what is planned when the entire equipment contemplated by the present improvement is in operation.

The company is the dominant buyer of Illinois field crude oil, taking probably

half of all its needs daily from Illinois wells. The crude, while an admirable lubricating crude, has never been especially noted for its high gasoline content recoverable by skimming. A 20 per cent gasoline recovery, possibly 25 under the best of conditions, was the rule from this crude of slightly better than 30 degrees Baume.

Increasing Recovery

What is happening now? Recovery of gasoline from crude oil in the Indian plant has mounted steadily under the operation of cracking equipment and other improvements, up past 50, to 60, 70, 75 per cent. Recovery of gasoline from a given throughput of crude oil occasionally exceeds 75 per cent, and with the additional improvements under construction or planned, it is expected this will be run up to 80 or possibly 90 per cent.

The Indian Refining Company is striving to get its refining operations to as nearly as possible 100 per cent gasoline recovery—always excluding lubricating oil from the consideration. It will, of course, continue to produce large quantities of high grade lubricant. But, as for its regular refinery operations, it is going to the status of strictly a gasoline plant as rapidly as possible. The output of fuel oil has been consistently reduced and the company looks forward to a time when it may expect to do away with the fuel oil factor virtually in entirety.

What the Indian Refining Company has and is doing divides itself naturally into two parts, one the story of management and sales and the other technical operation and improvement. The first named division will be considered first.

The Indian Refining Company has not always been a company administered "on the spot." In fact, until about two years ago, Lawrenceville was the seat of the refinery and New York City the home of the general management of the company. It had always been considered as it has been and is today by many companies, that there were great advantages accruing to a company administering affairs from New York regardless of the situation of plant. That was the situation when Col. Graham as president came to an important decision and sold the board of directors on the idea. The decision was to pick up the general offices of the company and move westward to Lawrenceville.

"With our general offices and our sales offices in New York City, naturally we saw the territory close to our sales offices as our field for selling," says Col. Graham. "So we were bending our efforts on sales in the New England States and the upper Atlantic seaboard.

Getting Quick Action

"That meant long freight hauls and we had to absorb the freights to compete with nearby refiners who got their crude oil by pipe line and tankers. That laid a heavy penalty on us.

"Next, there was the problem of management and policy. A sales idea might develop. Letters, telegrams and telephone conversations over long distance would follow. Days would pass—weeks perhaps —and still it would be argued back and forth. Sometimes, before a decision was reached, the time to act would be gone. Delays were costly, wire tolls between plant and office cost several thousand dollars a month. We decided to take the offices to the plant."

The action has had a result which should be of interest not only to oil refiners, but to a great many business organizations in other industries. Indeed, since the move, the economics of this particular action has been studied by business men throughout the country.

The rent alone in New York had cost the company more than $5000 a month, to say nothing of the expensive communication costs and other items. So the company built a substantial, three-story office building on the refinery grounds, just outside the Lawrenceville city limits. The cost of that building, which supplies satisfactory housing to all the company's headquarters offices, was less than one year's rental in New York City.

Move Brought Saving

Next, the question of employes. Of the 300 employes in New York, 200 agreed to go West with the company. The company agreed to stand the expense of the move for these workers, their families and all household property. Some 75 per cent of those who left the New York offices are still with the company. Fifteen per cent were sent back because fewer persons could do the work and do it better in Lawrenceville than New York. The other 10 per cent returned for their own reasons.

On the count of employe working conditions, the move has been completely successful. The employes have liked the change. They have found better working conditions, light, fresh air, fewer distractions. Workers are buying homes who could not have bought them in the East. Many own motor cars who could not have done so. Children are being permitted greater advantages.

"I believe we cut down in tangible and intangible expenses, $250,000 a year," says Col. Graham—in itself a considerable profit for a refinery operation in a year.

Aggressive Management

What did the first twelve months in Lawrenceville do to the Indian Refining Company's balance sheet? It did plenty. In the first year the balance sheet was improved $1,500,000, according to the estimate of officials. More than that, there were many other advantages not the least of which was the covering of the nearby market and the realignment of markets and outlets, which in itself deserves a good deal of space in this article.

The Indian Refining Company was organized more than 20 years ago. The administration of Col. Graham as president, however, has been rather brief to date, as he was only a director in the company until a little more than two years ago. George C. Armstrong as vice-president in charge of operations, is actively charged with the success of the refining operations of the company, while B. H. Anglin, as vice-president and director of sales, holds one of the most important positions in the company. Dr. Frank Fritz, vice-president and assistant to the president, also is an important figure in the company's activities.

The company's Lawrenceville plant covers about 300 acres. Its storage approximates about 1,500,000 barrels. It operates something like 1800 tank cars.

Former Oil Man Heads Big Tank Car Concern

Chicago, Ill.—Announcement is made of the election of Victor H. Smith to a vice-presidency of the North American Car Corporation, Mr. Smith having severed his official relationship with the Lion Oil Refining Company with whom he has been connected as vice-president.

Prior to his association with the Lion Oil Refining, he was secretary of the Imperial Oil Refining Company of Ardmore, Oklahoma, previous to which he had eight years of railroad traffic and operating experience. The Lion Oil Refining Company has, under Mr. Smith's management, grown from a small beginning with $100,000.00 capital to its present prominent position in the independent oil refining business with $6,000,000.00 capital.

The North American Car Corporation was organized by Henry H. Brigham of Chicago, and began business with small capital in 1907 and has grown to one of the largest car operating concerns in the country. The company operates refrigerator and tank cars, owning and operating in excess of 3000 cars. It has plants at Chicago; New Orleans; Tulsa, Oklahoma; Coffeyville, Kansas. The company not only operates tank cars and refrigerator cars, but also builds and repairs all kinds of freight car equipment. They also operate oil storage and terminal facilities at Chicago, New Orleans and Tulsa, doing a general warehousing business in liquid products including petroleum products, molasses, creosote, vegetable oils and chemicals. These plants are operated in connection with the company's tank cars and present plans involve the expansion of its activities in this line.

Mr. Smith's wide experience will be of great benefit to his new connections and the various interests they serve in the export, import and terminalling of petroleum products and their general contact in the Petroleum Industry.

The company has enjoyed very active demand for tank cars due to increased motor fuel loading throughout the country caused by rapid growth in automobile, truck, bus and tractor uses.

Leasing contract has been closed recently for 300 cars to one of the major oil companies, and current demand from other sources has made it necessary that the company acquire the additional equipment outlined in its recent financing plans, namely, the addition of four hundred tank cars.

Quoting from a discussion between Mr. Walter C. Teagle, President, Standard Oil Co. (N.J.), and Mr. Geo. S. Davison, President, Gulf Refining Co., before the Federal Oil Conservation Board at Washington, D. C., February 10th and 11th, 1926:

(From the official record as printed by the Government Printing Office, Washington)

"Mr. Davison. May I ask Mr. Teagle a question? Mr. Teagle, so long as fuel oil remains the cheapest source of gasoline will not the economic tendency be to absorb the fuel oil regardless of the general level of gasoline prices?

"Mr. Teagle. Absolutely. You would not run on a higher-priced crude if you could make the same product out of a cheaper crude.

"Mr. Davison. So that the question as to what the price of gasoline is at the present time is not, after all, the determining factor. *The determining factor is, is it not, Mr. Teagle, the cheapest source of gasoline supply,* and therefore *the economic tendency is to install cracking facilities and crack the fuel oil?*

"Mr. Teagle. That is the whole point that I tried to make in my paper yesterday."

(*Italics used are ours*)

Universal Oil Products Company
Owners of the Dubbs Process
310 South Michigan Ave
Chicago, Illinois

Rapid Method for Determining Litharge Percent in Doctor Solution

LET it first be said that full credit for this method for the determination of the approximate per cent of litharge in "doctor" solution, and discussion of same, as given in the paragraphs following, is to be given to Guy S. Mitchell. Mr. Mitchell, now an employe of the Barnsdall Corporation, "worked out" both the method and the accompanying chart while employed as a research chemist in the laboratories of Producers and Refiners Corporation's Parco, Wyo., refinery. At various periods of time during the past two and one-half years, when occasion warranted, this method has been used at the Parco refinery and has been found to be sufficiently accurate to meet the purpose for which it was devised.

The advantage of the method lies in the fact that it permits the rapid determination of litharge in doctor solution, with an error not greater than 5 per cent, and hence makes possible—with small laboratory labor and material expense for so doing—a greater uniformity in the doctor solution used in "sweetening" light oils.

Value

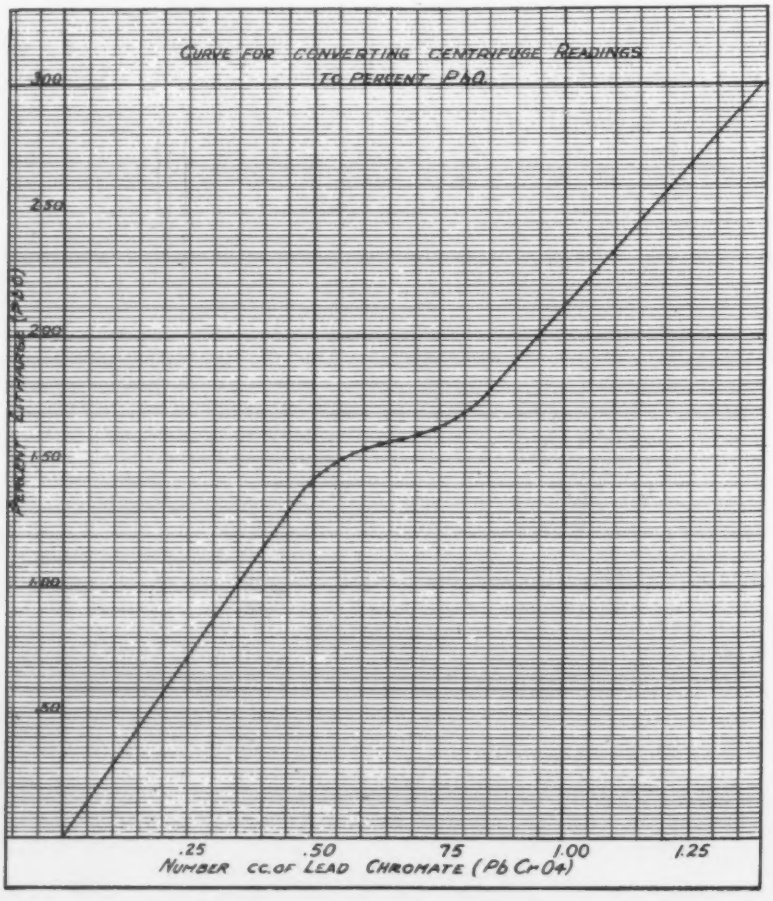
In this connection, mention should be made of the fact that, in treating light oils with doctor solution, more uniform results can be obtained if the per cent of litharge dissolved in the caustic solution is kept as near constant as possible. It is usually advisable to saturate the caustic solution with litharge, but as saturation takes place slowly, a laboratory determination of the quantity of litharge in the doctor solution will show whether or not the amount desired is present. Greater dependence, thereafter, can be placed in the doctor solution in the treatment of light oils, since, by so doing, the treater *knows* definitely that his "doctor" contains that particular percentage of litharge by the use of which best results are obtained in the treatment of a particular oil.

The ordinary gravimetric determinations of lead require more time and more skillful manipulation than are desirable for control work of this kind. Hence, the method following was developed to combine the element of speed with sufficient accuracy for such control tests.

Method

Measure 10 cc. of the doctor solution to be tested in a 10 cc. graduated cylinder, pour into a beaker, and wash out the cylinder with 20 cc. of water. Neutralize the solution in the beaker with acetic acid, and add a sufficient excess of acid to dissolve the precipitate that forms. Then add 10 cc. of a 10 per cent solution of potassium dichromate, boil for 2 minutes, and then dilute with water. Now wash the contents of the beaker, carefully, into a B. S. tube of the Goetz type and centrifuge for 15 minutes.

In making the tests upon the results of which the chart (Fig. 1) was based, a centrifuge was used having a diameter of swing of 18 inches (from top to tip of the whirling tubes.) This centrifuge was operated at a speed of 720 revolutions per minute. The tubes were of 100 cc. capacity, but instead of accepting the tenths of a cubic centimeter graduations, in which the narrow part of the tube was divided, this bottom portion was further calibrated and marked in *twentieths* of a cubic centimeter.



Results

To obtain the results from which the curve given in Fig. 1 was plotted, a 34.6 Baume doctor solution (containing 2.51 per cent of litharge) was used in making up "standard solutions," each solution varying in the per cent of litharge contained therein. The method described above was then used in determining the per cent of litharge in each of the standard solutions. In each case, the number of cubic centimeters of lead chromate thrown down was read directly from the centrifuge tube.

Table I summarizes the results obtained:

TABLE I

Gravity of Doctor Solution.	Lead oxide (PbO) in Doctor Solution as Determined Gravimetrically by Dichromate Method.	Reading of B.S. Tube; i.e. number of Cubic Centimeters of Lead Chromate ($PbCrO_4$) Thrown Down.
°Baume.	Per Cent.	
34.6	2.5	1.15
33.1	2.2	1.05
29.8	2.0	0.92
28.5	1.8	0.82
24.5	1.5	0.51
21.3	1.2	0.41
9.0	0.5	0.14
3.1	0.2	0.07

The curve shown in Fig. I was prepared by plotting the readings of the centrifugal tubes against the per cent of litharge as determined gravimetrically by the chromate method. This curve is com-

NATURAL

GASOLINE

DEPENDABLE SERVICE

BECAUSE OF THE GENERALLY IMPROVED QUALITY OF NATURAL GASOLINE, IT HAS FOUND A READY MARKET WITH REFINERS, NOT ONLY FOR USE IN THE MANUFACTURE OF ORDINARY U. S. MOTOR FUEL, BUT IS BEING EXTENSIVELY USED TO IMPROVE THE HIGHER GRAVITY "EXTRA QUALITY" GASOLINES

CHESTNUT & SMITH CORPORATION

GENERAL OFFICES CHESTNUT & SMITH BLDG.
TULSA, OKLAHOMA.

posed of two straight lines, which are deflected so as to meet each other. The line from zero per cent to 1.5 per cent represents the narrow, cylindrical portion of the tube, while the second line represents the funnel-shaped portion.

To use the method as a whole, the lead chromate is precipitated from the doctor solution in the manner described, and the number of cubic centimeters of lead chromate formed is then determined by centrifuging the entire solution and reading directly from the centrifuge the cc's of lead chromate thrown down; then, referring to the chart to ascertain the per cent of litharge in the doctor solution for a given volume of lead chromate as determined by the centrifuge method.

Particular attention is called to the fact that, since this method is based largely on the compactness with which the precipitate of lead chromate settles, the centrifugal force of the centrifuge is an important factor. The curve in Fig. I was plotted for, and is directly applicable only when there is used, a centrifugal force that is the same as was used in making these tests. *A different curve would have to be determined when a centrifuge giving any other centrifugal force is used.*

Conclusions

The centrifuge method affords a rapid means of determining litharge in doctor solution with an error not greater than 5 per cent.

Tetra-Ethyl Gasoline Regulations Proposed

Washington, D. C.—Proposed rules and regulations for the handling of gasoline with a tetra-ethyl lead content have been prepared by the United States Public Health Service for submission to the States. The rules are not final, since further research will be made. As now formulated they are for study by State authorities. They will be considered at a conference of Federal and State health authorities here in May.

The following regulations were prepared by the United States Public Health Service in accordance with recommendations of the Surgeon General Cummings committee, under which an investigation of tetra-ethyl gasoline was conducted:

Manufacture and Blending

1. No person shall be employed without adequate instructions as to the nature of the hazard and the precautions to be taken.

2. Each worker shall have a periodical physical examination which shall consist of such physical and other tests as are indicative of the absorption of tetraethyl lead and shall include, as a minimum, the follwing items:

(a) Examination of blood for stippling by carefully trained workers, using positive and negative controls, without knowledge of the source of the slides; this examination shall be once a week for the first four weeks, and bi-monthly thereafter.

(b) Semi-monthly contact with plant physician for informal statement as to general health.

(c) Bi-monthly weight, stripped.

(d) Bi-monthly systolic and diastolic blood pressure estimation while sitting.

(e) Bi-monthly hemoglobin estimation by Dare's hemoglobinometer. Exact records of these examinations shall be kept. and persons showing gradually increasing amounts of strippling, sudden development of strippling, or other marked deviation from normal, shall be promptly excluded from tetraethyl lead work, irrespective of whether or not such finding may be indicative of lead poisoning.

Sanitary Regulations

3. All parts of the plants where lead in any form is used shall be subject to sanitary measures to prevent collection and dissemination of lead dust.

4. Separate ventilation systems shall be provided for the manufacturing apparatus, and for the air for the rooms, the outlets of the latter being located near the floor of each room.

5. Daily inspection shall cover efficiency of ventilating systems, all joints, valves, and gaskets of manufacturing apparatus, and adequacy of pressure-hose respirators.

6. All containers of ethyl fluid or tetraethyl lead shall be labeled as to exact content and danger and shall conform to the regulations of the Interstate Commerce Commission. These containers shall be carefully tested for leaks and shall bear a plainly legible label stating that they are to be closed tightly immediately when emptied, without cleansing, and sent back to the plant.

7. Kerosene or other material used for cleansing the used containers of ethyl fluid or tetraethyl lead shall be placed in the containers by means of a closed system with air vents to outside air and with adequate ventilation.

8. The filling shall be performed by means of a closed system with air vent from the container to the outside air, and with adequate ventilation.

9. A dye shall be added to ethyl fluid in sufficient amount to give staining qualities to the ethyl gasoline, to deter individuals from using it for cleansing or other similar purposes.

10. Reports shall be made monthly to the appropriate officer of the State concerned covering the following points: Number of workers employed at beginning of month; number of workers employed at close of month; number of new workers; number of workers separated from tetraethyl lead work on account of results of examinations; number of definite cases of poisoning; condition of cases of poisoning previously reported so far as known.

1. The maximum content of tetraethyl lead in commercial ethyl gasoline or other ethylized motor fluid shall be in the proportion of 1:1260 by volume for commercial tetraethyl lead, or 1:1300 for Pb $(C_2H_5)_4$ C. P.

2. Ethylizing except for certain specific requirements such as research, military and naval use, and air mail service shall be done only at the main distributing centers and in not less than tank car lots. Adequate provision shall be made at each such center for thorough mechanical mixing of the ethyl fluid with the gasoline, and the efficiency of such mixing shall be controlled by the anaylsis of samples.

3. The location of these centers and the names of persons engaged in ethylizing shall be reported to the State Department of Health of the State of employment.

4. As few persons at each center as practicable shall be employed for this work.

5. No person shall be engaged for ethylizing until adequately instructed as to the mechanics of ethylizing, the dangers, and the precautions to be taken.

6. The distributor of ethyl fluid shall provide a special corps of adequately trained instructors and service men.

7. All ethylizing shall be done in the open or if some protection is necessary on account of the weather, adequate ventilation shall be provided.

8. Operation of the pumps shall be instantly stopped at the appearance of a leak or other defect and no attempt shall be made to repair or disconnect the system until a qualified man takes personal charge of it.

9. Floors of all places where any possibility of spilling is present are to be provided with drains and proper facilities for making possible a complete flushing out of all spilled fluid, or in their absence provision shall be made for chemically neutralizing any spillage as it occurs.

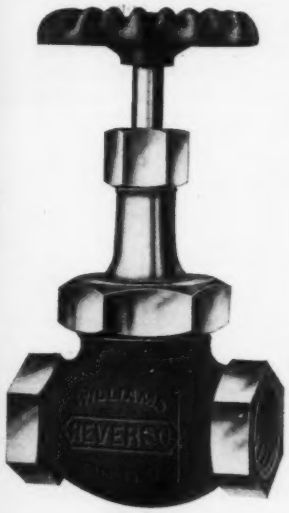
10. No bulk mixing station shall be dismantled or disconnected for repairs except by a qualified man.

11. A can of kerosene and washing facilities shall always be conveniently available.

12. The rules and instructions affecting the employes shall be posted in a conspicuous place where the ethyl fluid is being handled.

13. The distributor of ethyl fluid shall, with the advice of the United States Public Health Service, select a representative group of at least 40 men exposed to the hazard of ethylizing. Monthly fo the first three months, and every fou months thereafter this group of employes shall have an examination, which shall consist of:

(a) Examination of blood for stip-



No. 780

CUTS VALVE COSTS IN HALF

Costs count these days and the cost of a valve is by no means its first cost. Figured on the cost per year of leak tight service, the Reverso valve wins its way with the closest buyers.

The Reverso is a long lived valve. It outlasts the ordinary valve many times over because of its higher seat vitality.

But the most conspicuous feature is the reversible disc and seat, a decided economical advantage giving 100% more seat life—the life of two valves in one—all at no extra cost.

Reversible — regrindable — renewable, Reverso has every element necessary to long life and low maintenance costs. Once in the line, the Reverso is there to stay. No more replacements or excessive upkeep expense—no more wastage or production losses to drain away profits.

2 Valves In 1

REVERSO

The Valve with the Reversible Disc & Seat

REVERSIBLE
REGRINDABLE
RENEWABLE

The Height of Valve Efficiency

All that could be expected in high grade valve construction is found at its best in the **Reverso.** Note its liberal proportions—the rugged construction—the perfection of each detail, which, coupled with high quality of materials and workmanship, give the **Reverso** the strength and stamina to meet with a liberal margin the increasing severity of present day service conditions.

EASY TO REPACK UNDER PRESSURE—This stem is gland packed in all sizes ¾" and up, is fitted with a heavy packing nut and is of sufficient length to provide ample space for repacking, with valve closed or wide open under pressure.

UNION RING CONSTRUCTION—The hub of the **Reverso** is secured to the body by a heavy union ring—a more efficient method than screwing the hub directly into the body, as the *union ring hub* construction not only facilitates regrinding as well as quick and easy access to body, but also provides a stronger joint, which is immune to thread corrosion.

NON-HEATING HAND WHEEL—Another good point is the malleable iron, non-heating hand wheel, firmly lock-nutted to stem, and the rim of which being corrugated provides a firm grip with a comfortable, convenient operation.

HIGH LIFTING DISC AND FULL AREAS—Its high lifting disc and free, full areas through body insure easy, unrestricted flow of steam or liquids with minimum friction.

NON-STRIPPING STEM—Another advantage of the **Reverso** is its heavy, substantial stem with full cut, Acme threads, making uniform and complete contact over their entire length, eliminating stripping or excessive wear at any particular point.

UTILITY—Intended for steam, water, oil, air or gas, the **Reverso** has a wide range of usefulness which is further increased by the immunity of the **Niculanium** disc and seat to certain acids and acid contaminated liquids making it the ideal valve for power plants, oil refineries, or any of the diversified industrial requirements.

GUARANTEE—Furnished in Globe, Angle, Cross and Check Types, Screwed or Flanged Ends, Medium Pattern guaranteed for 200 pounds working pressure—total maximum temperature 550° Fahr.

NOTE—For pressures up to 150 pounds we recommend our **Iroverso,** an exact duplicate of the **Reverso,** except the body is of iron instead of bronze.

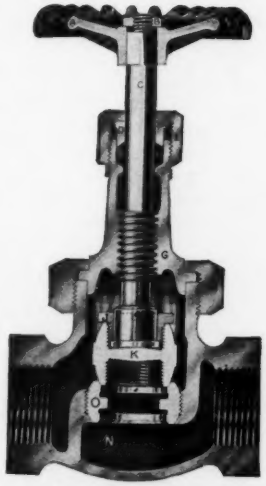


Fig. 780-S

A—Malleable Iron Hand Wheel
B—Brass Wheel Nut
C—Bronze Stem
D—Brass Packing Gland
E—Bronze Packing Nut
F—Graphited Asbestos Packing
G—Bronze Hub
H—Bronze Union Ring
J—Bronze Disc Lock Nut
K—Nickel Alloy Disc
N—Bronze Body
O—Nickel Alloy Seat

THE D. T. WILLIAMS VALVE CO.
CINCINNATI, OHIO

Williams Valves

Bronze & Iron Globe— Angle — Cross — Gate — Check — Hose — Needle — Hydraulic — Quick Opening

Mention Where You Saw the Advertisement

pling, by carefully trained workers, using positive and negative controls, without knowledge of the source of the slides.

(b) Examination of fecal samples of lead.

(c) Report as to general state of health.

(d) Weight, stripped.

(e) Blood pressure estimation, diastolic and systolic, when sitting.

(f) Hemoglobin estimation by Dare instrument.

(g) Exact records of these examinations shall be kept.

14. The results of the examinations shall be reported promptly to the surgeon general of the Public Health Service.

Distribution

1. Each filling station shall have prominently displayed at the pump, or in other conspicuous place, the following warning or one of similar effectiveness: "Ethyl gasoline is to be used as motor fuel only and not for cleaning or any other purpose."

2. Suitable leaflets shall be available at all filling stations where ethyl gasoline is sold, for distribution on request. These leaflets shall describe the possible dangers and precautions to be taken in the use of ethyl gasoline.

3. Containers of ethyl gasoline sold to the general public shall be labeled: "Ethyl gasoline containing tetraethyl lead. To be used for motor fuel only."

Garages and Stations

1. Automobile garages or repair shops holding more than five cars and all public service stations and filling stations for automobiles should be registered with the local health department.

2. In addition to doors and to window-ventilation in summer, automobile garages, repair shops, service stations, and filling stations should have permanently operative ventilation at least equivalent to that given by an opening or openings at ceiling level free to the outside air, but protected from down drafts, with cross-section of 0.2 per cent of the floor space available for cars, together with an opening or openings for inlet near floor level of corresponding effectiveness, both arranged to give positive dilution of exhaust gases as generated. This is to be taken as a minimum, special conditions requiring greater permanent ventilation.

3. Automobile garages, repair shops, service stations and filling stations should be kept reasonably clean and free from dust by means of flushing out and moist sweeping or vacuum cleaning.

4. Automobile garages, repair shops, service stations, and filling stations should keep conspicuously posted a copy of these regulations with the following statements in large type:

Automobile exhaust gas is dangerous. Motors should not run longer than 30 seconds unless the car is in motion or the exhaust is directly connected to the outside air. Liquids sold as motor fuel, except ordinary gasoline, should be used only as motor fuel, and not for cleaning or other purposes. The fumes from the evaporation of even ordinary gasoline may be injurious.

A Simple Test for Determining The Hardness of Water

By Ralph E. Goode

THE element water is a very interesting study. Everyone is familiar with the fact that three-quarters of the earth's surface is water, that even our bodies are largely composed of water and that without this fluid in some form or other we would, as would all vegetation, disappear from the face of the earth in a remarkably short time.

Water is formed by a composition of hydrogen and oxygen. Chemically pure water is odorless and tasteless. It is found in three different physical states: as solid—snow, hail or ice; as liquid, as in wells, lakes and streams. The green color of the ocean's water is due to organic matter in suspension or solution.

Water evaporates even when cold, with a definite vapor pressure for every temperature. It does not boil until 100° C. unless the vapor pressure above it is less than 760 millimeters pressure. It freezes under the same conditions at 0° C. When we heat a beaker of water bubbles of dissolved air gases being set free form on the sides of the glass long before the liquid boils. The presence of CO_2 in water increases the solvent action of water to a marked extent, especially on limestone rocks. Dissolved air in water gives it a pleasant taste. Distilled water tastes flat due to the lack of air.

Good, clean, pure water is of prime importance to the operation of steam-making equipment. Water that enters the boilers should be as free from impurities that clog up and form scale as it is possible to make it. When the plant's boilers are continually being shut down for cleaning and tube repair due to scale forming compositions in the water, serious inroads are made upon profit side of the ledger. Scale causes the majority of shutdowns, and its prevention is primarily the main object in treating boiler water.

Plants located in the "hard" water belts are forced to maintain treating plants for their boiler water in order to rid themselves of the nuisance of coked boiler tubes. The hardness of water is caused chiefly by the salts of Ca and Mg. It is generally measured by the soap-destroying power of the water. The solubility of carbonates of Mg and Ca beyond certain limits depends upon the presence of CO_2 and the normal carbonates are precipitated. Precipitation, however, is not complete, as the normal carbonates themselves have a slight solubility.

The hardness of water removed by boiling is called "temporary" hardeners. The hardness which remains is called "permanent" hardness. This due to the sulphates and chlorides of Ca and Mg and traces of carbonates still held in solution.

The "permanent" hardness of water can be removed in several different ways. There are on the market a number of different treating methods for boiler feed water, but a simple, effective and economical plant that will give good results on different water is what is to be desired. A system that will treat one water will not treat or be effective on another. The first in importance is finding and locating the cause of the trouble.

This can readily be ascertained in the laboratory by testing the water. A simple test to determine the hardness of water is to measure out 100 cc's of the water sample into a 4-ounce bottle. Fill a burette with the standard soap solution. Add the soap solution ½ of a cc at a time, shaking the bottle well, and continue until the lather begins to form. Add now less soap solution each time, about 2/10 or 3/10 of a cc at a time. Continue this until the lather forms, which will remain standing for 5 minutes. Lay the bottle on its side and let it stand for some time, and if the bubbles do not break up the end point is reached. Note the number of cc used and subtract ½ cc for the blank, and then the remaining number of cc's used expresses grains per gallon of hardness.

This, of course, will not give an indication of the method to pursue in treating the water to remove this hardness. This can be determined only by an analysis of the different compositions in the water. A water the hardness of which is composed largely of the salts of Ca and Mg can be effectively treated by the use of caustic soda, lime and soda ash. The tendency though will be to overtreat. This can be overcome by the laboratory and a balance obtained which will give an indication of the proper amount to use. This treatment can be carried on at small expense at the plant. Many different compounds have been tried, but the expense and uncertainty incident to their use in treating water has been a bar to their universal use.

STOP PIPE CORROSION
IN SMALL LINES

Our Simplex Prepared Joint Cast Iron Pipe is made in 2″, 3″, 4″ or 6″ diameters. Since it has been available thousands and thousands of feet of this material has been used in the oil fields.

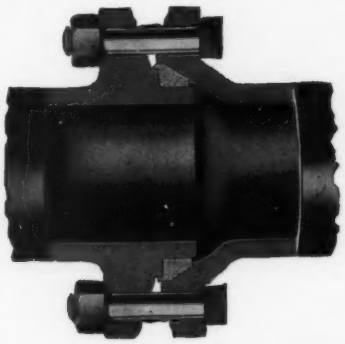


Illustration of section through assembled joint of Simplex Prepared Joint Five-Foot pipe, showing asbestos endless ring gasket in place. This gasket is adapted to use for oil, vapor and acid lines. A rubber gasket is compounded to suit the particular service it is to render—steam, natural gas, artificial gas, water, oil, etc.

Its chief advantage lies in its immunity from corrosion as compared with other ferrous pipe. Its desirability is further increased by the special joint, with only two bolts, and with a thick, endless ring gasket. It is rapidly and easily laid by inexperienced men.

Wherever permanent construction is desired, it is little short of an economic crime to spend money for a pipe line of perishable material when a practically permanent construction can be obtained by the use of cast iron.

Do you know why cast iron withstands corrosion so much better than any other ferrous metal? Our Bulletin No. 44 explains it.

Simplex Prepared Joint Pipe is furnished with full line of fittings. The material is fully described and illustrated in our Catalog No. 48. Your copy is waiting to be mailed, upon receipt of your request.

American Cast Iron Pipe Company

General Offices and Foundry: Birmingham, Ala.

Branches at
Dallas, Kansas City, San Francisco, Los Angeles, Chicago, New York, Minneapolis

Write Also for Information on Our
Simplex Cast Iron Pipe for Oil Condensers

Petroleum Refining Capacity Required in the United States

By Chas. L. Parmelee
Consulting Engineer, New York City

(Before Semi-Annual Meeting of the National Petroleum Association)

IT is commonly said that one of the difficulties with the petroleum refining industry in the United States is over capacity. While it is true that measured in gross barrels of possible output there is an apparent excess capacity, it is not true that there is an excess of adequate refining capacity. In fact, when the required finished products are considered, there is indicated an apparent shortage at the present time and for the near future, a large deficiency.

The first and fundamental factor controlling this situation is the character and amount of available raw material. In 1925, there was produced in the United States and imported a total of about 818,000,000 barrels of crude oil. Of this, about 10 per cent was not considered refinable by present processes. While there is little reason to expect any material change in the available supply this year, it is to be borne in mind that price incentive has heretofore and may again result in added supply and that under the urge of insufficiency of finished products, new means may be developed for the refining of these crudes now used as fuel oil.

The demand for motor fuel is steadily increasing. If the January-February 1926 figures are taken as a criterion, and for the past five years they have given a remarkably uniform guide to the year's consumption, the 1926 demand for domestic and export motor fuel will be about 320,000,000 barrels. Various estimates place the figure at from 280,000,000 to over 320,000,000, the latter being the estimate of one of the largest oil concerns in the world. A domestic and export consumption of 295,000,000 barrels in 1926 has been used in these computations as a very conservative figure.

The domestic demand for motor fuel in 1930 is estimated by the Committee of Thirteen, A. P. I. as 315,000,000 barrels. If to this is added 40,000,000 barrels for export, the 1930 demand is indicated as about 355,000,000 barrels. This may be reached in very much less than four years.

The available supply of natural-gas gasoline, benzol and imports may be taken as 31,000,000 barrels for 1926 and 35,000,000 for 1930, leaving 264,000,000 and 320,000,000 as the indicated demand for petroleum motor fuel from U. S. refineries for these years.

In 1925, the average natural gasoline obtained from the crude oils run to stills was less than 23 per cent. The present indications are that the total available crude oil supply will be maintained only by increasing the havy oil output. The supply of light oil appears to be steadily decreasing. If the heavy oils are refined, the percentage yield of natural gasoline will be reduced. There is, therefore, no reason to expect any increase in this yield from the crudes run in the next four years.

If sufficient crude oil of the same grade as run in 1925 was available and all of the refineries in the United States in operation January 1, 1926, were operated at 85 per cent rating for the year, there would be produced about 180,000,000 barrels of natural gasoline and about 90,000,000 of cracked gasoline, or a total of about 270,000,000 barrels This is less than 3 per cent in excess of a most conservative estimate of the demands for this year, and 16 per cent less than a very authoritative estimate. The possibility of this condition arising is affected by two major factors.

First, there is required about 795,000,000 barrels of refinable crude oil, or 7.4 per cent more was run to stills in 1925, when 18,000,000 barrels of light oil was drawn from storage. The supply of refinable crude may be increased if the price justifies the cost, but there is little prospect of any material increase at an early date.

Second, under the present price structure a very large number of refineries have been and are operating at a loss. Several have been shut down since the first of the year.

Under present price conditions, no refinery that is not constructed and operated in the most efficient manner can operate at a profit, and of such refineries only those that fall in one of three groups can show reasonable returns.

1. Those refineries which are classed as "Complete" and can adjust their output to those commodities which are most profitable.

2. Those refineries which by reason of crude supply, special products or established market can secure a better return than the average price differential.

3. Refineries equipped to produce the maximum possible gasoline yield from the crude.

The average skimming and topping plant can only operate at a loss today.

Of the refineries operating January 1, 1926, 196 of a capacity of about 697,000 barrels per day were classified as skimming and topping plants. Of these, 58 had cracking equipment of a charging capacity of about 163,000 barrels per day. Rating the economic crude capacity of these skimming plants as the same as the cracking capacity, omitting their excess capacity and including full capacity for all other refineries, the total crude capacity indicated is about 2,028,000 barrels per day, or about 629,000,000 barrels per year. This is the total economic crude capacity of the petroleum refineries in the United States under the present price structure, if all these refineries fall within the limitations above given. It is well known that many of them fail to meet the efficiency specification. These refineries can produce about 227,000,000 barrels of motor fuel, or about 37,000,000 barrels short of that which is necessary to meet a most conservative estimate of the apparent gasoline demand for this year, and 93,000,000 barrels short of that which may be needed in the very near future.

These conditions will result in the crude supply being absorbed to their full capacity by those plants which are most efficient, premiums being paid therefor, if necessary. The price structure will then change to encourage further crude production and to permit the operation of sufficient less economical plants to provide for the production of the necessary commodities. This will result in increased profits for the more efficient plants which will thus be encouraged to expand. The price structure will then adjust to something like its present ratio which will again put the inefficient plants on a non-profitable basis. This cycle will continue with the gradual elimination of all but highly efficient complete, specialty and gasoline plants except in a few instances where other conditions are especially favorable. If this elimination is permitted to take its full course there will be lost and duplicated a present investment of upwards of $70,000,000, a large part of which can and should be conserved.

Two tables have been prepared to show the indicated demand and supplies under various conditions in 1926 and 1930, or earlier. All figures given are not absolute or exact. They are suggestive only and are subject to possible wide variations from the facts as ultimately developed. The limitation put on the possible production by shortage of crude must be borne in mind.

In the left hand section are given certain estimates of the probable demand. These require no explanation.

The refining capacity of the United

The Holmes-Manley *Cracking* Process

Evidence of our faith in this process and our patent protection is reflected in our large investment. The Texas Company has in operation 79 Holmes-Manley units

The Licensee receives:—

1. *A Proven Process*
2. *Complete Technical Service*
3. *The Benefit of Future Developments*

Licenses Granted by

THE TEXAS COMPANY, U. S. A.

Apply to

R. C. HOLMES, *President*

17 Battery Place, New York, N. Y.

States which was in operation January 1, 1926, has been divided into two classes.

Group A. Skimming and topping plants in excess of the installed cracking capacity therein. Total capacity 534,372 barrels per day.

Group B. All other refineries. Total capacity 2,028,000 barrels per day.

Group B includes nearly all of the Pennsylvania and West Virginia refineries. They are assumed to have a special field by reason of their established market. As will be shown, there is ample demand for all the products of these refineries at full capacity, provided they are on an efficient basis. Insofar as they are abandoned, it will be necessary to supply equal capacity elsewhere.

Table No. 1 shows that the refineries of the United States cannot supply the probable motor fuel demands for 1926, unless a considerable portion of the simple skimming and topping plants are operated. The kerosene shortage could be supplied by these refineries, but as it will be necessary to operate some of the skimming plants this amount could be most readily furnished by them.

Table No. 1 shows that to supply the motor fuel and kerosene demands, about 73 per cent of the capacity of the plain skimming and topping plants will have to be operated, if operating on selected crudes yielding 30 per cent natural gasoline. By running about 123,000,000 barrels of 30 per cent gasoline crude in such plants, the necessary motor fuel and kerosene can be obtained.

The combined refinery operations above indicated call for 752,000,000 barrels of crude oil per year, or about 17,000,000 barrels more than the new crude, refinable by present methods, available in 1925. The indicated shortage will result in changes in price structure and withdrawals from stocks of crude and motor fuel. Price structure changes may temporarily encourage operations of additional skimming plants.

It is the spasmodic and irrational operations of the smaller skimming plants that has resulted in over-production of finished products and in serious disturbances in the industry. Insofar as the laws of supply and demand will permit, no encouragement can be expected from the larger operators toward any change in the price structure which will warrant such operations. Of the skimming plant capacity in excess of the cracking capacity, (Group A) the major refining concerns own or control about 40 per cent.

While no great increase in cracking capacity can be expected this year, it is to be noted, as shown in last column of Table No. 1, that if full cracking plant capacity is installed by the addition of 212,000 barrels capacity (about 22 per cent increase of present cracking capacity) about 40 per cent of the capacity of skimming plants not now so equipped is required to provide the motor fuel and kerosene apparently needed.

Table No. 2 shows the same data

(Continued on page 88)

Table No. 1.
INDICATED CONDITIONS FOR 1926

DEMAND			SUPPLY				
			GROUP "B" REFINERIES			Group "A" Refineries (Alternatives)	
					Shortage	Skimming Only	Full Cracking
Motor Fuel: Domestic	260,000,000						
Export	35,000,000						
Total		295,000,000	Number of Refineries	214			
Deduct: Casing Head	25,000,000		Crude Capacity (per day)	2,028,000		396,000	212,000
Benzol	2,000,000		Cracking Capacity (per day)	968,000		.....	212,000
Imports	4,000,000		Crudes per year	629,000,000		123,000,000	62,000,000
			Natural Gasoline per year	142,000,000		37,000,000	18,500,000
Total		31,000,000	Cracked Gasoline per year	85,000,000		.....	18,500,000
Refinery Gasoline Demand		264,000,000	Refinery Gasoline Supply	227,000,000	37,000,000	37,000,000	37,000,000
Kerosene		60,000,000	Kerosene	50,000,000	10,000,000	10,000,000	10,000,000
Diesel Engine Oil	15,000,000						
Lubricating Oils	30,000,000						
Wax	2,000,000						
Asphalts and Road Oils	20,000,000						
Misc. Refined Oils	8,000,000						
Total		75,000,000	Misc. Refined Oils	75,000,000	.....	.....	.....
Fresh Gas Oil	30,000,000						
Fresh Fuel Oil	150,000,000						
Total		180,000,000	Fresh Gas and Fuel Oil	66,000,000	114,000,000	72,000,000	.....
Gas and Fuel Oil Residuum Usable		180,000,000	Residuum, Gas and Fuel Oil	164,000,000	16,000,000	.....	11,000,000
			Coke, Fuel and Loss	47,000,000		4,000,000	5,000,000

Note: All Quantities in 42 Gallon Barrels.

Table No. 2.
INDICATED CONDITIONS FOR 1930

DEMAND			SUPPLY				
			GROUP "B" REFINERIES			Group "A" Refineries (Alternatives)	
					Shortage	Skimming Only	Full Cracking
Motor Fuel: Domestic	315,000,000						
Export	40,000,000						
Total		355,000,000	Number of Refineries	214			
Deduct: Casing Head	30,000,000		Crude Capacity (per day)	2,028,000		1,000,000	530,000
Benzol	3,000,000		Cracking Capacity (per day)	968,000		.....	530,000
Imports	2,000,000		Crudes per year	629,000,000		310,000,000	155,000,000
			Natural Gasoline per year	142,000,000		93,000,000	46,500,000
Total		35,000,000	Cracked Gasoline per year	85,000,000		.....	46,500,000
Refinery Gasoline Demand		320,000,000	Refinery Gasoline Supply	227,000,000	93,000,000	93,000,000	93,000,000
Kerosene		60,000,000	Kerosene	50,000,000	10,000,000	10,000,000	10,000,000
Diesel Engine Oil	30,000,000						
Lubricating Oils	35,000,000						
Wax	2,000,000						
Asphalts and Road Oils	20,000,000						
Misc. Refined Oils	8,000,000						
Total		95,000,000	Misc. Refined Oils	95,000,000	.....	.....	.....
Fresh Gas Oil	30,000,000						
Fresh Fuel Oil	150,000,000						
Total		180,000,000	Fresh Gas and Fuel Oil	46,000,000	134,000,000	198,000,000	.....
Gas and Fuel Oil Residuum Usable		180,000,000	Residuum, Gas and Fuel Oil	164,000,000	16,000,000	.....	40,000,000
			Coke, Fuel and Loss	47,000,000		9,000,000	12,000,000

Note: All Quantities in 42 Gallon Barrels.

JENKINS CRACKING PROCESS

PRODUCES QUALITY GASOLINE

Facts from performance

CRACKING LOSS

In checking the performance of the Jenkins Process you will find a cracking loss of 2 1/2%. This loss is the total fixed gas and soft carbon produced. The former can easily be used for fuel, and credited to the operation.

This low loss is the result of not over cracking the oil, which would cause, in addition to a higher loss, much inferior products.

GRAVER Corporation Founded 1857

EAST CHICAGO, INDIANA

NEW YORK Grand Cent. Term. | CHICAGO Steger Building | TULSA Atlas Life Bldg. | HOUSTON West Building

Mention Where You Saw the Advertisement

DEALING IN PERSONALITIES

It may have happened before. If so, it has not in the memory of this writer been recorded.

Anyway, here it is, set down so that all who scan will know that F. A. Pielsticker did resort to use of the Latin language in delivering an address of welcome.

What difference did it make that few of his hearers retained a speaking acquaintance with the language of the land of spaghetti. (Or did Latin come from the Nile, Cleopatra speeding it to Italy by inoculating Marc Antony with the charm of soft words?)

Before he closed, Pielsticker explained himself by coming down to facts and admitting that he meant only "howdy.". Besides that most of those present were having such a good time they did not care whether he welcomed them in Latin, Greek or the language of the Fiji Islands.

The occasion was the meeting of Committee D-2 of the American Society for Testing Materials. The Western Petroleum Refiners Association gave a banquet in honor of the scientists and it fell upon Pielsticker to deliver the address of welcome, whereupon there was enough Latin to convince anyone that the study of the ancient language is not wasted time.

All of which gets around to a question, rather two questions. Did F. A. Pielsticker break a precedent? Or did he set a precedent?

In either case it was not a new role for him to be playing.

Two years ago when Pielsticker was elected president of the Western Petroleum Refiners Association, he had to make a speech. It is not recorded that he used any Latin in it. But he did say something to the effect that all meetings during his tenure of office would begin on time.

That was taken as so much applesauce, for no one thought of breaking the precedent of late meetings and wretched attendance in deliberations of the Association. Such had gone on too long.

Shortly afterwards there was a called meeting of the board of directors in Kansas City. The hour for the meeting came and not enough men were on hand to load a flivver. But the session began. Members straggled in and began to ask what had transpired, for proceedings were moving forward regardless of sparse attendance.

Whereupon the stragglers were informed that the one and only way to know what had transpired in a meeting of the Western Petroleum Refiners Association, its committees or its board of directors was to be present to see and to hear it transpire.

F. A. PIELSTICKER

And it is a fact that the affairs of the Association have had more attention and better attendance in the two years that F. A. Pielsticker was president than for any other two years of its history.

The fact that F. A. Pielsticker believes in promptness may have had no more to do with this than the fact that he can ring in a few words of Latin in a welcome address.

When not engaged in conducting the affairs of the Western Petroleum Refiners Association or some other outside duty, Pielsticker spends his time in managing the refining branch of the Skelly Oil Company. He is vice-president of that concern makes Eldorado, Kansas, headquarters.

Shreveport, La.—F. W. Garnjost has been elected vice-president and general manager of the Crystal Oil Refining Corporation, which has been formed to replace the Caddo Central Oil & Refining Corporation. The concern has two refining plants here.

F. W. Burford also has been elected a vice-president of the new concern. He comes from the Skelly Oil Company, where he has had charge of retail sales. He assumed his new duties April 1.

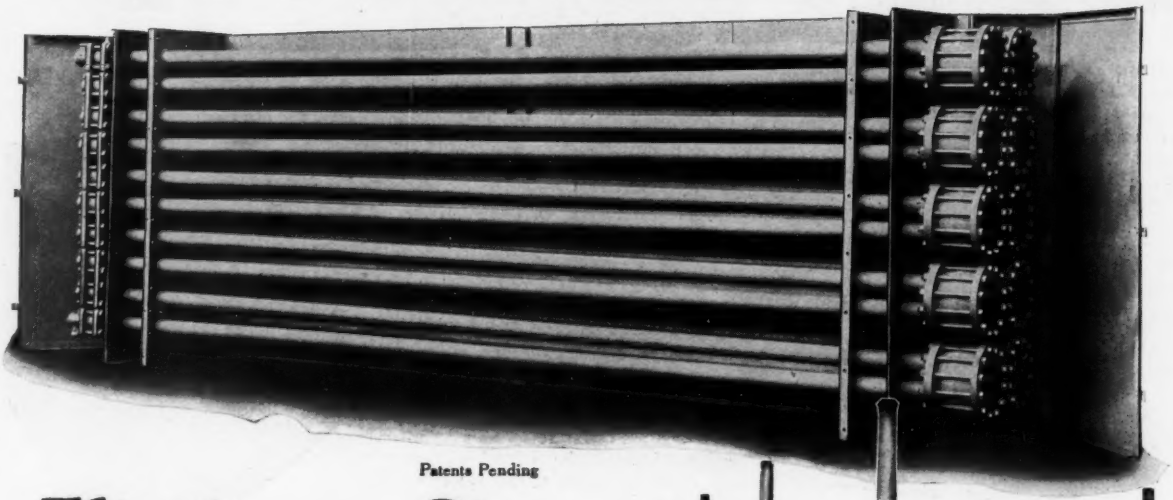
J. Stickel, sales manager for the Crown-Central Refining Company in the Southwest district, spent the first part of April traveling throughout the Mid-Continent section.

G. H. Hartung, general manager of the Houston Oil Refining Company's refinery at Camden, Ark., was an honored guest of the A. & M. College Ex-Students Association of Houston April 5.

Mr. G. M. Brigham, General Manager of the North American Car Corporation's Tulsa branch, has been elected a vice-president of the Traffic Club of Tulsa. The name of this organization has just been changed from the Transportation Club of Tulsa and its scope of activities considerably enlarged.

Bartlesville, Okla.—Ralph H. Espach, engineer with the Empire Gas and Fuel Company, has resigned to go with the United States Bureau of Mines, Bartlesville Station, as assistant refinery engineer.

NO STUFFING BOXES



Patents Pending

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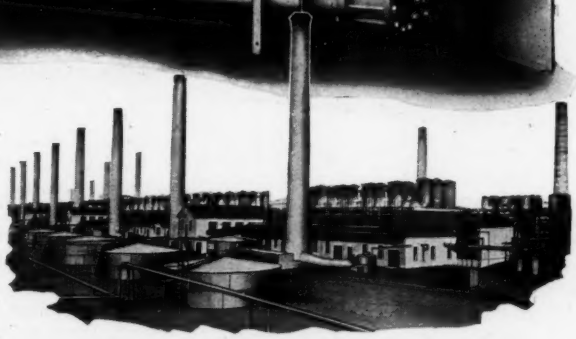

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For High Pressures & Temperatures

THE VOGT counter current oil heat exchanger is designed to exchange temperatures at one thousand degrees Fahrenheit with pressures to six hundred pounds. To take care of the expansion and contraction of the tubes due to the high and fluctuating temperatures, stuffing boxes have been eliminated entirely. Large chambers connecting the tubes are provided at one end of the exchanger where the fittings that connect the inner tubes are allowed to float in and out as the tubes expand and contract. An additional advantage obtained through the elimination of the stuffing boxes is the lessened possibility of leaks and fire through flashbacks.

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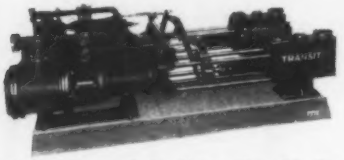
RECENT ITEMS IN PLANT EQUIPMENT

National Transit Announces Twin Hot Oil Pumps

Transit Twin Single Hot Oil Pumps manufactured by the National Transit Pump and Machine Company, Oil City, Pennsylvania, are claimed to offer a number of advantages in handling hot oil. To secure the necessary "Uniform Flow" and still retain the positive full-stroke of the single pump, this company has placed two single pumps side by side and put a synchronizer between them.

This synchronizing arrangement makes possible a uniform flow, since



National Transit Twin Single Hot Oil Pump

through its use at the same time the piston on either side reaches the end of its stroke, the piston on the opposite side begins its stroke. The result is an even discharge.

To guard against a breakdown, either of the two single pumps comprising a Transit twin single hot oil pump is made large enough to handle the capacity required at normal pump speed. In other words, when running synchronized, they operate at approximately one-half normal speed, insuring an easy running, slow-speed, long stroke, and consequently long-lived machine.

A simple manipulation of the synchronizer cuts out the pump in need of repair without hindering the other side. Throwing the control to the left, when standing at the right-hand side of the pumps, causes the pumps to operate independently, or as two singles. Throwing the synchronizer control to the upright position stops both pumps practically instantaneously, without touching the throttle valve.

In an emergency, with compond pumps, live steam can be admitted to both the low pressure and high pressure steam cylinders at the same time. Thus, with a very much reduced steam pressure, the hot oil pressure can still be kept where necessary.

In order to prevent leakage at the piston rods, these pumps are equipped with a very deep stuffing box; so deep that the hot part of the rod never runs up into the packing. This stuffing box is provided with a water jacket and the course of the water through the jacket is directed by means of a spiral fin around the stuffing box, so that the maximum cooling is obtained for a minimum amount of water. In addition to the long rod fit and deep stuffing box, a lantern gland is provided to guard against leakage. Any possible leakage past the packing strikes the lantern gland, where the pressure is released and the oil piped off to the suction again. The lantern gland is held in place by several rings of packing to insure that no hot oil escapes into the air to take fire.

Additional information will be supplied by the company on request.

Plunger Pump Introduced By Hills-McCanna

Designed to meet the demand for a means of delivering liquids against pressure, in measured quantities over a definite period of time, the Hills-McCanna Plunger Pump is now being introduced to the refinery trade.

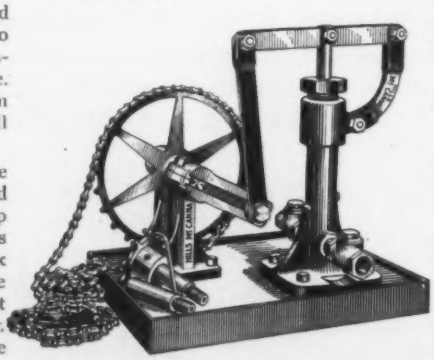
The pump is made in cast iron and steel for handling sodium aluminate, boiler compounds, caustic soda and various water treatments, and in special corrosion resisting non-ferrous alloys where the service demands this construction.

In the accompanying illustration the unit has a three-quarter inch piston and the piston stroke can be regulated from 0 inches to three and one-half inches in length by easy adjustment on the eccentric arm. A plug for relieving air binding is provided in the pump body, and ball check valves are provided as regular equipment. The entire device is mounted on a plate fitted with a beaded edge to take care of spillage. Bolting holes for mounting are provided in the base plate.

The stuffing box is designed for long and efficient service.

Drive may be accomplished by chain, motor drive through reduction gears, or by direct connection to reciprocating pumps.

Further details will be supplied by the company on request, addressing the Hills-McCanna Company, 2025 Elston Avenue, Chicago, Illinois.



Hills-McCanna Plunger Pump

Joseph Reid Special Type Look Box

Substantial Construction Feature of Reid Look Box

A new type of Receiving Box designated as the Special Type has been designed by the Joseph Reid Gas Engine Company, Oil City, Pa.

Clean design and substantial construction feature this box which is made of a high grade cast iron with all machined parts carefully and accurately finished. The look windows are of polished wire plate glass, affording a clear view of the oil as it passes through. The circular look windows will withstand pressures of 10 to 15 pounds per square inch. Rectangular look windows can be furnished where the pressures do not exceed 5 pounds.

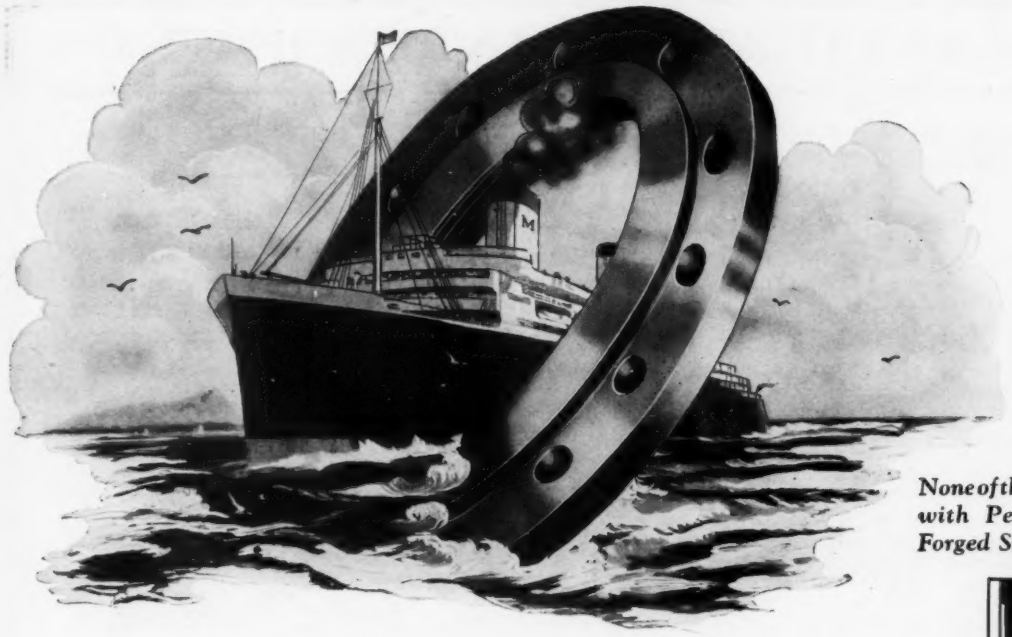
A gas and oil tight cap on top of the box affords access to the interior. This cap is held in place by an easily removable screw clamp. Waste gases are led away by a two-inch vent pipe.

Flanged connections for two, three or four-inch pipe can be furnished.

Further information on Reid Receiving Boxes and Manifolds will be given on request by the Joseph Reid Gas Engine Co., at Oil City, Pa., or by any of their branches or agencies.

Changing Tips Transforms Welder to Cutter

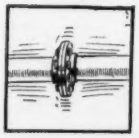
New advances in design and constant improvement in oxy-acetylene welding and cutting equipment have been a potent factor in adopting this equipment advantage-



None of these troubles with Pennsylvania Forged Steel Flanges

Breakage in transit

Breakage in installation

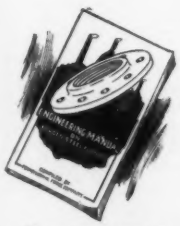


Breakage due to vibration

Breakage due to expansion

Breakage due to water hammer

When lives depend on the Flanges



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WHEN you step up the gang plank of a ship, you put your life in the hands of the builders of that ship. If they have overlooked any detail, your safety is imperiled.

The builders of the S. S. Malolo—the largest high-powered, and swiftest steamship ever launched in the United States—have taken every precaution for the safety of the lives with which they are entrusted. That's why they used Pennsylvania Forged Steel Flanges throughout.

A flange was needed that would give unfailing service—that could be depended upon under any and all conditions. They picked Pennsylvania Forge Flanges. Here are a few reasons why: Pennsylvania Forge Flanges have a tensile strength of 60,000 lbs. as against 22,500 lbs., the average tensile strength of cast iron.

The method of manufacture makes it impossible for Pennsylvania Forge Flanges to have any hidden defects such as blow holes, etc.

Forged Steel Flanges have as much ductility as the pipe itself. When the pipe expands or contracts, the flange expands and contracts in equal proportion.

Pennsylvania Forge Flanges may seem to cost more in the beginning, but they really cost less in the long run.

The strength of the line is only the strength of the Flanges

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RECENT ITEMS IN PLANT EQUIPMENT

ously to production problems as well as repairing and scrapping in the oil and refining industry.

Among the notable improvements, is the Milburn Combination Cutting and Welding Torch. This torch is transformed instantly from a cutter to a welder by a change of the tip. All operations of cutting or welding are performed with the one torch efficiently, economically. A great saving in time is also effected, as the time consumed in changing hose connections and connecting a new torch for each particular operation is obviated. In this combination torch the change of tips is made in a few seconds.

The seats of the tips are flat, with annular grooves coinciding with those in the head, the gas passage being drilled in the annular grooves or rings. The rings separate the gases. An outer protecting ridge prevents injury to the tip seat in rough handling. With the flat seat of the Milburn tip there is sufficient play for lateral expansion of the torch head and tip under the locking nut without cracking or distorting the head.

The Milburn "Cut-Weld" Torch is adapted to any gas, either from generators or compressed gas in tanks. The torch is made of bronze forgings and specially drawn triple thick brass tubing throughout; is very simple in construction with valve accessible; and the triangular ar-

Milburn Welding and Cutting Torch

rangement of three gas tubes connecting the head with the handle results in great transverse strength.

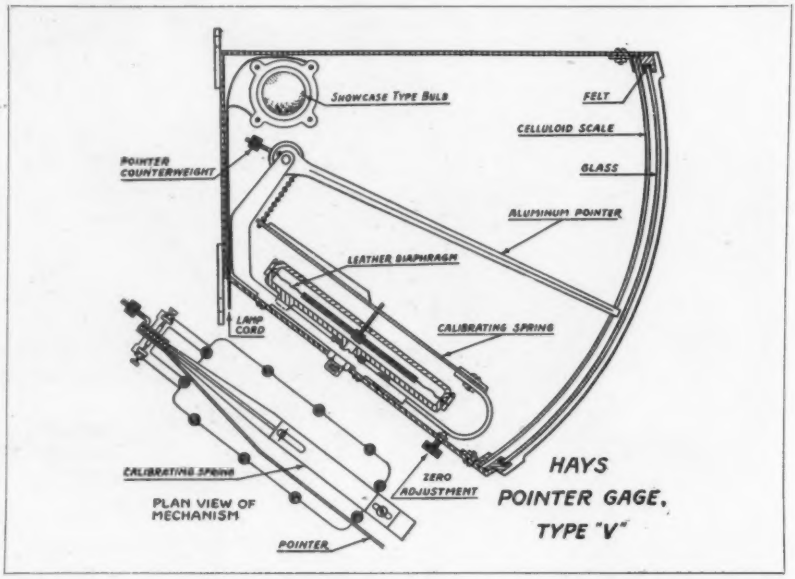
An angle of 27½ degrees in the head allows a natural position in operating the torch, at the same time utilizing the heat to best advantage and protecting the operator's hands. The torch is well-balanced and permits of continual operation without tiring the operator.

Literature will be mailed by The Alexander Milburn Company, 1416 West Baltimore Street, Baltimore, Maryland.

New Hays Gauges Can Be Read With Much Ease

To meet the demand for a dependable, simple, light and compact gauge, the Hays Corporation, manufacturers of Combustion Instruments, has just brought out the Types "F" and "V."

Type "F" has been developed for use in one or two units for showing the pressure or draft at one or two locations. Visible from a long distance and from any angle, this Gauge provides a wide range, readable scale. It operates directly upon gas pressure. Once this instrument is installed it requires no further adjustment. The entire front of the case can be quickly removed, making everything accessible. Adjustments to zero is a simple matter of adjusting a screw protruding from the bottom of the case, an operation required only when the gauge is first installed. All ordinary range of pressure up to 6" water can be measured upon this gauge.



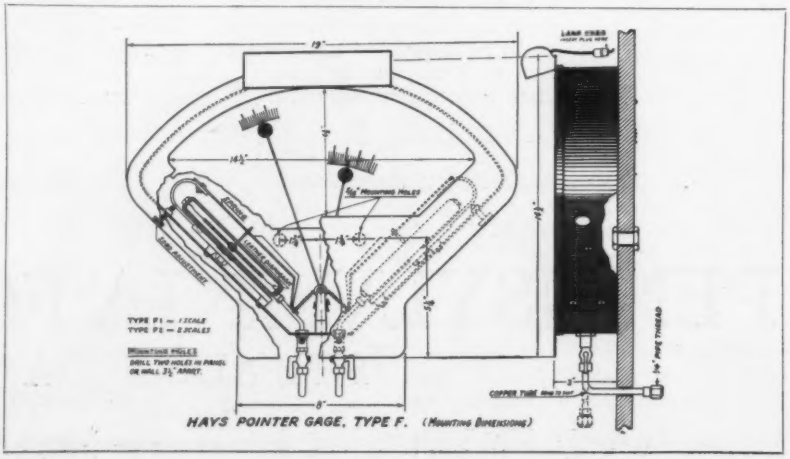
Type "V" is available in units of one to eight permitting the pressure or draft at from one to eight different points be taken simultaneously. This type of instrument gives a very compact arrangement occupying minimum space and at the same time affords great visibility. Readings can be read over considerable distance and from any angle. It should be noted that the scales are uniform, so making it an easy matter to read and interpret them. The unit is entirely self contained, simple, rugged, accurate and compact. The use of these instruments along side each other shows at a glance pressure or draft, enables one to interpret the true significance of conditions.

The scale measures 2¼ inches wide by 12 inches long. This gauge is capable of measuring pressure or draft a low as 1/1000th of an inch up to as great as 6 inches of water pressure, or higher if conditions require.

More detailed information will be sent by the Jos. W. Hays Corporation, Michigan City, Indiana.

Paint Gun Patented

Herbert W. Day, assignor to the Painting and Equipment Sales Company, St. Louis, was given a patent March 16 for an apparatus for applying coating. The patent, No. 1,576,725, covers several features of paint guns. The W. N. Matthews Corporation of St. Louis is the exclusive licensee under this patent.



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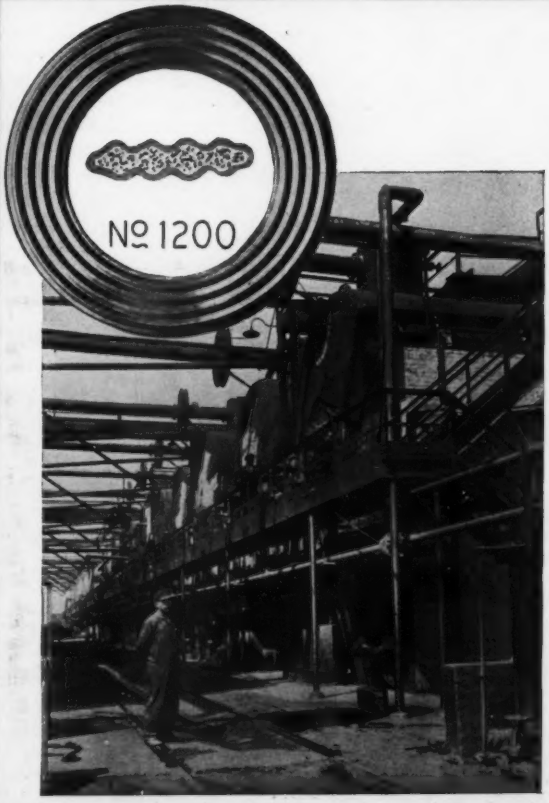

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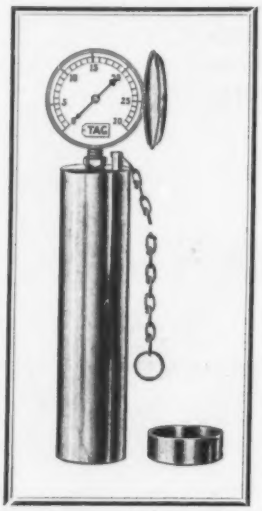

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High Heating Efficiency at Low Cost With Venturafin

Remarkably high efficiency at a low cost is claimed by the American Blower Company, Detroit, Michigan, for its Venturafin Method of heating. This method is well adapted to industrial buildings, warehouses, power plants, etc.

The outfit consists of a Venturafin Unit with recirculating box, made in several sizes.

Coils in the Venturafin heater are made from copper and brass. Venturafin tubes are made up of straight seamless copper tubing, about which is helically wound a brass ribbon in such a way that it forms a continuous "fin." This "fin" is so bent that a large surface of it is in contact with the outer surface of the tube, and this union is later treated so that the fin and tube becomes metallically integral.

The method of assembly is simple and strong: the tubes are arranged in rows, usually three deep and staggered. The ends of the tubes are pressed into a thin, flexible copper plate, the holes in which are slightly smaller than the tubes. This gives a tight, flanged connection.

On the Ventura fan which is a part of every unit, a large central disc prevents back flow of air through the fan wheel and propeller shaped blades give the maximum obtainable efficiency.

The usual method of installation is to place the Venturafin at the top of a steel housing so designed that cold or cool air is taken in from near the floor and discharged thoroughly heated, at a height of about seven feet. This insures constant and complete circulation of all air in the room.

Light construction of the Venturafin heater makes it possible to combine two or more units in a single housing without making it unduly heavy.

The unit can be made to discharge in any direction.

More data will be furnished by the company on application.

Hills-McCanna New Offices

Chicago, Ill.—The Hills-McCanna Company has recently announced the establishment of two new branch offices, one in Denver, Colo., in charge of Edwin McSheehy, 310 Patterson Bldg., and one in Tulsa, Okla., under the management of A. B. Harrison, 805 Mayo Bldg. The new offices will handle the sale of No. 45 Alloy and other corrosion resisting metals manufactured and marketed by the Hills-McCanna Company.

Class Provided

Los Angeles, Cal.—Prof. Charles A. Marsh, of the English Department of the University of California, Southern Branch, has been retained by the Pacific Gasoline Company to conduct a class in public speaking at the company's field office at Santa Fe Springs, Cal.

A large number of employes have signed up for the course, which begins April 12 and embraces ten or more sessions.

Venturafin Heater

New Plant for Arkansas

El Dorado, Ark.—Sufficient gas contracts have been obtained from owners of producing leases in the Lisbon field, Arkansas, by George Dykes and associates, of Shreveport, for the construction of an absorption gasoline manufacturing plant. Materials for the erection of a 2,500,000 cubic foot daily capacity plant will be purchased by Dykes early in May, and construction work will follow as soon as deliveries can be made. The plant will be located about seven miles east of El Dorado, and a gasoline yield of two gallons per thousand cubic feet of gas is expected from the plant.

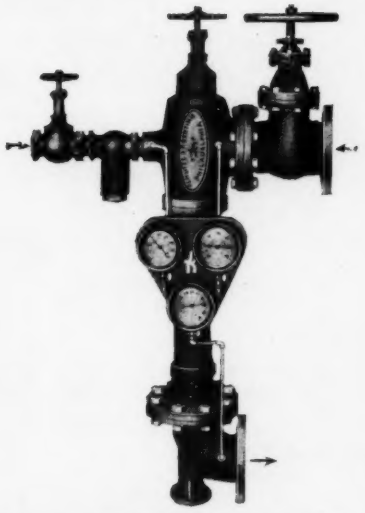
El Dorado, Ark.—A small natural gasoline plant unit is to be erected shortly by the Root Refineries to operate in connection with its skimming and cracking plant at El Dorado. The natural gasoline plant will handle gas from the Dubbs cracking stills, fire stills and from the various tanks used in storing gasoline. About 2,000,000 cubic feet of gas is expected to be available around the refinery and a daily production of about 2500 gallons of natural gasoline will be obtained. The natural gasoline plant will cost about $25,000.

Shreveport, La.—The Shreveport Producing and Refining Company plans to install a natural gasoline plant to operate in connection with its refinery located near Shreveport, and take off the gas from the stills, tanks and feed lines. The plant will cost about $23,000, and will have a daily yield of 1100 gallons of natural gasoline.

Exhaust steam can be boosted for Oil Stills

by using the

STEAM JET Thermo-Compressor



Operate with live steam, entrain exhaust steam, and discharge at 5 to 20 pounds pressure.

Use up exhaust steam, reduce consumption of live steam, and eliminate reducing valves.

Bulletin 4-F is interesting—send for it.

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Electrical Heating for Oil Mixing Tank

Boogerd and A. Booden in Petroleum Zeitschrift
Pages 92-94, 1926

(Translated by Ismar Ginsberg)

IT is a fact that in spite of the many uses to which electricity is put in the heating field, heat installations operated with electricity and of large size are still exceptional. It is therefore of some interest from several standpoints to describe a heating installation which is run with electricity, in which the important advantages that are to be gained directly from electric heating are made possible mainly by making the proper selection of the heating system.

The electrical heating installation, which shall be described in the following, is used in the governmental petroleum storage depot of Amsterdam, Holland, for the purpose of heating oil in an oil mixing tank.

As the name of the tank indicates, it is used for the purpose of mixing together various kinds of petroleum oils in order to obtain an oil mixture which shall have certain definite, desirable characteristics. The mixing process requires the use of a comparatively high temperature and this is of course dependent on the character of the oils that are to be processed in the tank.

At the outset attempts were made to carry out the heating process by means of steam and electricity, but after investigation it was determined to build the heating system for electrical heating. The various grounds on which the solution of the problem was finally arrived at are interesting and are indicated in the following. They clearly bring out the fact that electricity possesses certain very important advantages over steam for this purpose and in selecting a heating system for such and similar purpose it will always be wise to take these points into careful consideration so that the best system possible under the existing conditions may be selected. These points are as follows:

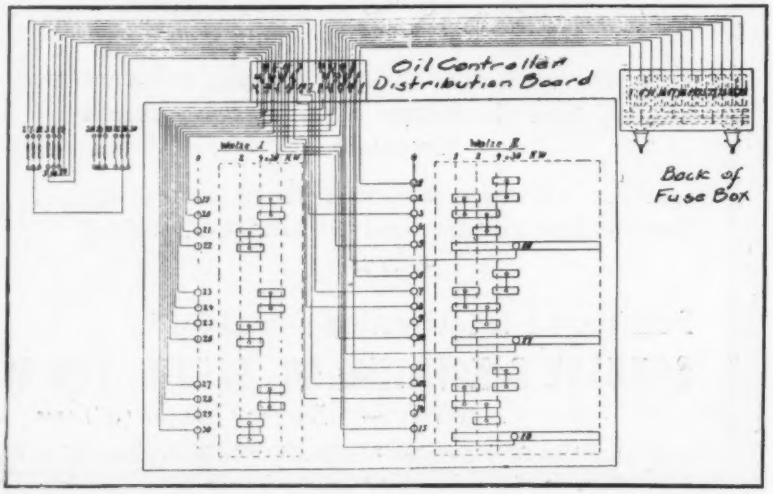


Figure 2

Disadvantages of Steam

In the first place, it was found that steam for heating the mixing tank had to be transported to the tank quite a distance away from the boiler house, about 350 meters. The reason for this is evident for an open fire was prohibited in the vicinity of the oil storage depot. This would apply almost anywhere. It was found after careful calculation that the costs of a steam arrangement would be approximately as great as an electrical installation of the same size and capacity, but it was thought inadvisable to operate the plant with such a long steam line that had to be run from the boiler house to the mixing tank with resulting amount of condensation and loss of steam values.

Then again certain experience had already been gained along these lines, because in the regular operation of the governmental petroleum storage depot a steam boiler had been operated in this manner, that is the steam had been used in a mixer which was located at a distance from the boiler house. It was found that a single boiler was not sufficient to keep the mixer supplied with the necessary amount of steam and it was accordingly necessary to use another boiler to produce the required steam. This then meant that there was no boiler in reserve at the boiler house, and in addition thereto, the costs of the installation were materially increased.

In the third place, it is a fact that when the mixing tank is operated with steam, there are certain maintenance and attendance charges which have to be figured, and which are not incurred when electrical heating is employed for this purpose.

Another disadvantage of the steam installation is that it is not possible to set the mixing tank into operation and be sure that it will be properly heated, unless the boiler house itself is kept in the proper operating condition. In other words, the

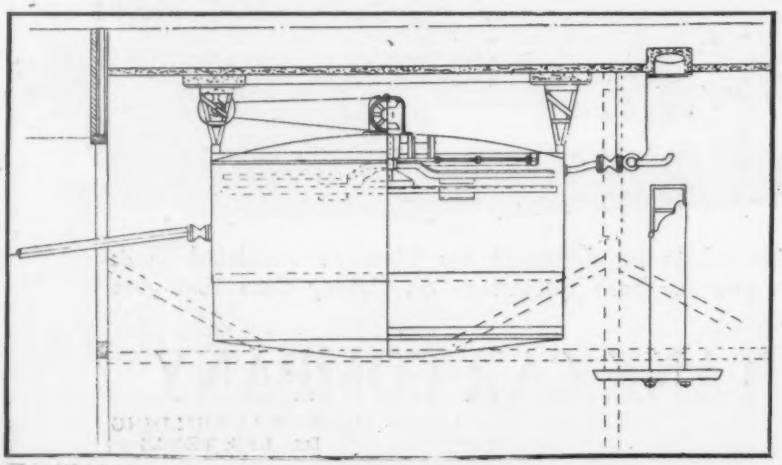
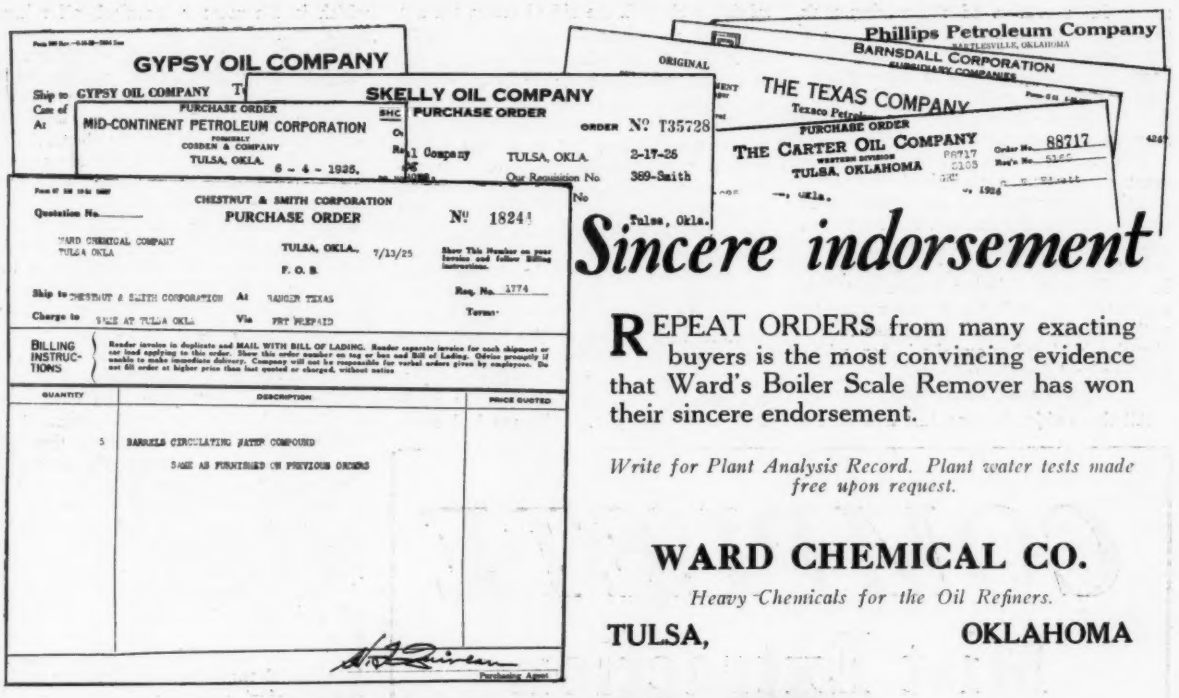


Figure 1.—Mixing oil tank for electrical heating with stirring equipment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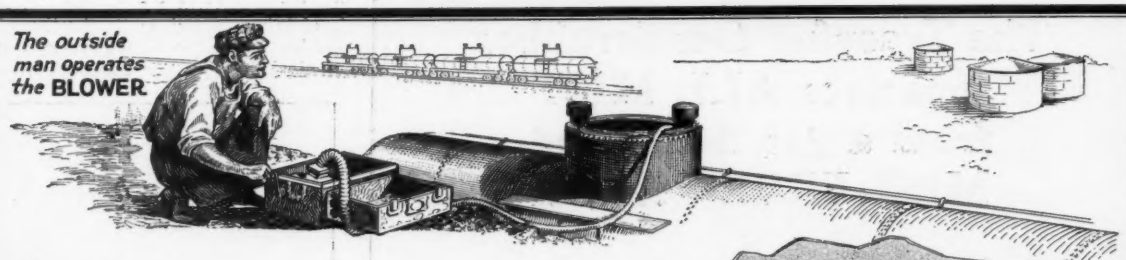

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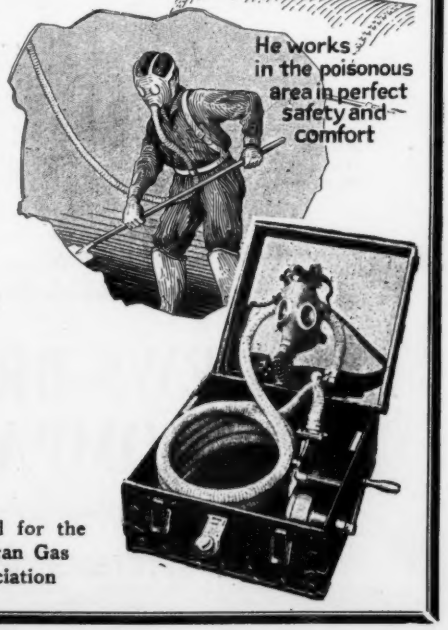

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Standard for the American Gas Association

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successful operation of the mixing tank depends on the manner in which the boiler house itself is operated. On the other hand, the electrical heating arrangement does not depend on any such outside conditions, and is always ready for use the moment the current is turned on.

Finally, due to the fact that there is a great distance separating the boiler house and the mixing tank the condensate which collects in the pipe line can not flow back again into the boiler. The result is that a certain amount of heat goes to waste in the form of this hot water, and it is necessary to feed the boiler constantly with fresh water. This gives rise to difficulties in cleaning out the boiler, which are not to be underestimated.

Electricity Costs More

All these objections against heating the mixing tank with the aid of steam are not removed, as might be expected in other times and under other conditions by the fact that there is a rather great difference in the cost of steam and that of electricity. It is, of course, true that electricity costs more, but it is the better heating agent for this purpose. The advantages that are to be gained from its use are so great and so significant that the added cost is hardly an item. It is not always the cheapest fuel or the cheapest machine or substance that is the cheapest in the final analysis, for the costs that are involved in the use of the material or machine and the results that are obtained must also be given due consideration. It is only in this way that a really equitable comparison between them can be made and a correct solution be reached as to which is the most economical, all things being considered.

There is, of course, a great difference between the consumption of coal and that of electricity, and it has been estimated that it would be necessary to pay as much as six times as much for the electric current as for the coal. But the advantages are great enough to overcome this cost and to decide the case for electricity instead of steam as the heating agent. Actual experience with the electrically heated installation has shown that it is the one to be preferred in spite of the greater cost of electricity as the heating medium.

Equipment Described

In Fig. 1 there is shown a cross sectional sketch of a mixer tank which has a diameter of 4.8 meters and a capacity of 24 cubic meters. It is required to maintain that quantity of oil in the tank for a period of six hours, during which time it is heated from an original temperature of zero degrees C. to 100 degrees C. This then means that the temperature of the heating medium must not go beyond 110 degrees C., in order to avoid the decomposition and the coloring of the oil by decomposition products, mainly carbon.

In connection with this requirement it is essential that the wire that is used as the electrical resistance be employed in the form of a band or ribbon, which is located in a vertical position on the top edge of the tank. At the same time a stirring arrangement is also built into the tank.

The energy that is required for effecting the heating of the oil, etc., is calculated in the following: In the first place for heating up the oil the energy that is required is equal to 24,000x0.9x0.4x100

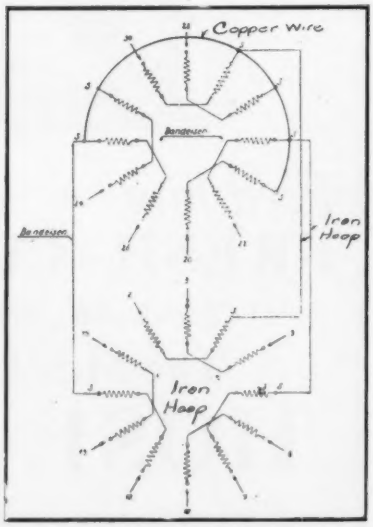

Figure 3.—Connections of resistance elements

or 864,000 kilogram calories. This corresponds to 168 kilowatts, which is found by solving the fraction,

$$\frac{864{,}000}{6\text{x}3600}\text{x}4.2$$

In order to heat up the iron metal of the tank itself as well as of the stirring equipment with which the mixing tank is fur-

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nished, the amount of heat required will be 23,000 kilogram calories, which is found from the from the following calculation: 2000x0.115x100. The electrical energy that corresponds to this heat energy is approximately 4.5 kilowatts.

Inasmuch as the mixing tank must be located in a room which is not heated in any way, the heat that is lost by radiation must be taken into consideration in figuring the required consumption of electricity. This heat loss is calculated for the minimum temperature, which is zero degrees C.

Although it is a fact that at the end of the heating process a greater part of the energy that is fed to the installation is radiated and thereby lost than in the beginning of the heating, and although the temperature can rise more rapidly when it is in the neighborhood of zero degrees C. than when it is around 100 degrees Co., nevertheless, it is possible to attain results which are accurate enough for all intents and purposes by carrying out the calculation for an average tank temperature of 50 degrees C. in comparison with that of the surrounding atmosphere. This assumption is perfectly satisfactory, for the different radiation factors can anyway be estimated only with the greatest degree of approximation, while on the other hand, the energy represented in radiated heat amounts to only 10 per cent of the entire energy that is fed to the mixing tank.

Radiating Surface

The radiating surface amounts to approximately 42 square meters, and in making this estimation the bottom of the tank as well as the cover are considered to have but one-half the radiation effect that would be ascribed to their surface areas when this area formed the sides of the tank. This was done for the reason that the lowest layers of oil always are at a lower temperature than the layers that are found above the heat resistance elements. Then, again, it is to be noted that there is a sort of insulation of great or less potency, formed by the layer of air, which is interposed between the topmost surface of the oil and the cover of the tank.

With a radiation of 12W per square meter and at a temperature difference of zero degrees C. compared with the surrounding temperature there will be required 25 kilowatts of electrical energy to take care of the radiating loss. This figure is found by the following calculation: 42x12x50 or 25,000 watts.

The total energy that is consumed in the heating apparatus must therefore be equal to approximately 198 kilowatts of electricity. This load must be furnished to the mixing tank in a regular fashion and it must be controllable in a suitable manner, for it is a fact that the mixing tank makes very varied demand for energy on the heating elements during the process of mixing.

Heating Medium

One question that gave considerable trouble was the character of the heating medium. After careful consideration of all available materials it was found most advisable to make the resistance out of hoop or band iron.

The requirement that the temperature of the resistance element must not rise more than a few degrees only above the temperature of the oil that is being mixed in the tank made it necessary to make the surface area of the hoop iron resistance medium as large as possible. It follows moreover that the entire mass of the resistance element must remain at a comparatively low temperature in order to maintain the temperature of the oil as constant as possible. In conclusion, it must also be mentioned that it is necessary to take consideration of the fact that the cover of the mixing tank is made in sections, when constructing the heating element. One-half of the cover is held fast and the other is made in such fashion as to be easily removable. A part of the resistance medium must anyway be built into the mixing tank through this opening. For this purpose frames are built containing the strips of hoop iron, these frames being 2x12 sectors. The frames are made of wood and are placed one on top of the other in two layers.

The hoop iron is fastened to the frames by means of wooden bolts which are hammered into the sides of the wooden sectors. The iron bands are wound around in two layers in order to obtain the necessary surface area. Iron pegs are used to prevent the two layers from coming in contact with one another.

The uppermost sector is provided with the necessary boards so as to make possible an easy and unimpeded flow of current in the tank.

Figure 2 shows the manner in which the

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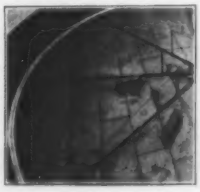
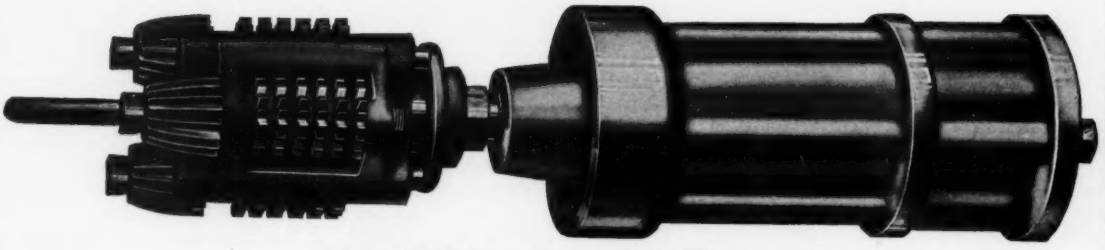


The Wiggins Roof, which minimizes evaporation by sealing the tank gastight, and which eliminates fire hazard, has advantages over any other type of roof. The photograph shows a Wiggins Roof on a large oil tank. The white band is the gastight seal.

RNGM5-Gray

ROTO TUBE CLEANERS



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heating arrangement was designed and operated. The safety fuses were placed in a specially constructed transformer house. These were built into a suitable box which was located right near a switch which controlled the flow of current to the tank. The current could be turned off both at the switch in the transformer house and also at a point near the tank.

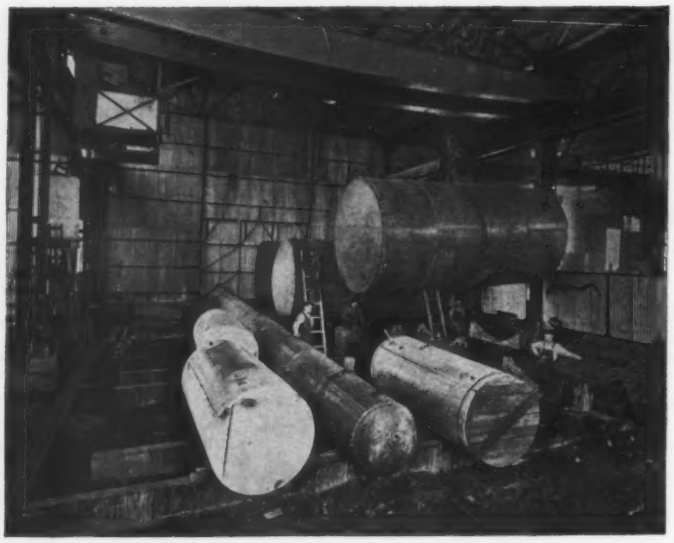
Wiring System

From the fuse box 12 leads led to the oil controller, and this apparatus was itself connected with 15 different wires to the resistance in the tank. All the connections were made with naked copper wire. In making the connections concentric clamps were employed. The resistance itself, which furnished the heat, consisted of 12 divisions and each division contained the resistance wire of two sectors. This is shown in Fig. 3. These sectors are not connected in series. This has the advantage of there being possible a sufficiently accurate distribution of the heat, in the case where the total heating energy is not required for the operation. This simply means that it is possible to secure correct heat distribution even though the entire amount of energy available is not being consumed for the production of heat. This would, of course, not be possible if the resistance elements were connected in series. The oil controller, or switch, is made with two rolls, which makes it possible to regulate the flow of the current with great accuracy, increasing or decreasing the current in small steps.

Very satisfactory results were obtained with this installation, as may be gathered from the following figures. A quantity of lubricating oil of 12,502 kilograms was heated up in a tank with the cover open and without any stirring from a temperature of 45 to 90 degrees C. The time required for this operation was one hour and forty minutes. The consumption of electricity was 295 kilowatt hours, so that when the specific heat of the oil was taken to be 0.4 the efficiency of the heating operation was calculated to be 89 per cent, in accordance with the following equation:

$$\frac{12502 \times 0.4 \times 45}{295 \times 3600 \times 0.24} = 89\%$$

The efficiency is greater with a covered tank and agitation.



View of Wyatt's Dallas Test Floor

The reputation a manufacturer has with his trade is built upon character. If the reputation is good the character of the organization in its adminstration, its operatives and its physical equipment will be found to be of the best. The purpose and will to do good work may be inherent but without the facilities the results will be unsatisfactory.

The facilities for testing shown in the above cut are representative of the care and thought that have been given to the equipment of the entire shop for building up the excellent reputation which this company enjoys thruout the entire Southwest in every branch of the Oil Industry where plate work is used.

Wyatt Metal & Boiler Works

Dallas, Texas

How to Conserve Steam in a Refinery

(Continued from page 25.)

sure mains are maintained at constant pressure.

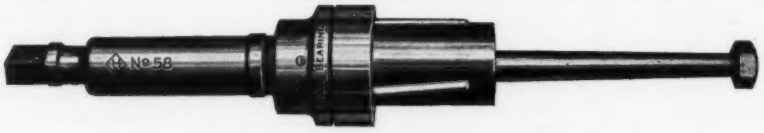
All conveniently located drips will be returned to the boilers. Any pumps or mechanical equipment far distant from the source of live steam will be electric driven. Electricity will be furnished by turbine driven generators. No particular effort to obtain low water ratings is necessary. Low first cost and reliability are the two first considerations in the choice of prime movers of all kinds for this service.

Thus all the power becomes in reality a by-product of the steam necessary in any case for process work. The only charges against the power costs are supervision, maintenance, depreciation and 7 to 10 per cent of the heat in the steam used. Where this system has been installed, costs for electricity as low as one-third cent per K. W. hour with coal at $5.00 per ton have been reported. No central station can compete on this basis.

The above is, of course, an ideal system and can not be adopted in full at one time by the average refiner. It should be held up as the ultimate goal, and all changes and new installations should be laid out with the idea of gradually developing to the point where all of the economies may be realized.

Charles C. Phelps, secretary and sales manager of the Uehling Instrument Co., Paterson, N. J., has just completed a ten weeks' trip visiting all of the company's Southern representatives as well as several in the Middle West. Most of this time was devoted in actual field work with the idea of better fitting the representatives to cooperate with users of Apex CO_2 Recorders and Fuel Waste Meters. Mr. Phelps made a special study of the application of these instruments in oil refineries, for which service they have been widely adopted.

HEAVY DUTY EXPANDERS FOR STILL TUBES



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EXTRACTS OF REFINING TECHNOLOGY

Determination of Tetraethyl Lead in Motor Fuels.—Fifty cubic centimeters of the gasoline are gently heated under a hood with fifty cubic centimeters of concentrated hydrochloric acid (density 1.19) in a round bottomed flask of approximately 250 cubic centimeters capacity fitted with a reflux condenser. In passing through the gasoline the gaseous hydrochloric acid generated causes the precipitation of lead chloride, the turbidity at first increasing in intensity and afterwards disappearing. When the liquid has become quite clear again, the gasoline and a considerable proportion of the aqueous liquid are expelled by distillation, the residue being transferred to a beaker and washed with boiling water. The liquid is then concentrated somewhat and mixed with absolute ethyl alcohol, the lead chloride being subsequently collected and weighed as usual. More accurate results are obtained by weighing as lead sulphate. For various gasolines and gasoline-benzol mixtures containing 0.421 per cent of lead tetraethyl by weight the latter method gave from 0.413 to 0.425 per cent. Giorn Chim. Ind. Appl. volume 7, pages 625-6.

* * *

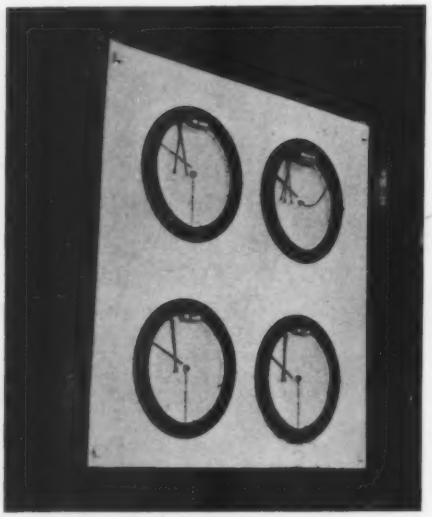
Purifying Used Lubricating Oils.—A resinate of a heavy metal, preferably manganese, is added to used lubricating oil before clarifying it by a solution of water glass. A twenty per cent solution of the resinate in benzol or oil is preferably used in the proportion of one part of resinate to 200 parts of the oil to be purified; 01. per cent of stearic acid may be added to the resinate. After the addition of the resinate one to four ounces of a solution of water glass of 40 degrees Be. concentration (density 1.384) is added per gallon of the oil. After mixing, the mixture is floated on water heated to a temperature of 80 degrees C. when the impurities subside as sludge. Any benzol used is removed along with the volatile ingredients in subsequent rectification. None of the reagents used remains in the clarified oil. British Patent No. 235,861.

* * *

Distillation of Mineral Oil.—The oil which is to be distilled, principally crude oil, from which the lower boiling fractions have been removed and from which the lubricating oil is to be extracted, is allowed to stand in a closed vessel and then is drawn from that vessel as necessary. This vessel is contained in a closed room, and during the passage of the oil through this room, it is artificially distributed over a large surface area and maintained under quite a high vacuum. Quicksilver is subjected to a certain amount of heating for the purpose of driving off quicksilver vapors, and the heat in these vapors is caused to be transmitted to the oil which flows in a closed system and which does not come into contact with these vapors at all.

The interchange of heat between the vapors of mercury and the oil results in the condensation of the latter vapors, and the latent heat of vaporization is thus given up to the oil, which results in the distillation of the lower boiling fractions out of the oil. These oil vapors are drawn off and then condensed, while the mercury condensate flows back into the mercury boiler. In order to remove oil vapors of essentially different boiling points and to condense these vapors, a series of evaporators are provided, each of which is provided with a chamber, through which the oil flows, as well as a heat exchanging device and a condensing space for the quicksilver vapors.

Distillation, which is carried out by this process, is free from decomposition or cracking of the oil, and hence distillates are obtained which do not have to be further treated with sul-



Change Still Operation From Art to Science

The four Foxboro Instruments illustrated above enable an operator in the compressor and pump room of a Bayonne, N. J., refinery to operate two stills located 200 feet distant.

The three pen thermometer records oil temperatures in the still, vapor outlet from still tower and temperature of condensate leaving the still. The two pen gauge records pressures in both stills. One orifice meter records the flow of steam to the still. The second meter records the flow of oil from the absorber.

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phuric acid and sodium hydroxide. German Patent No. 423,049.

* * *

Determination of Water in Mineral Oils.—For the determination of small quantities of water in mineral oil, the oil is heated to a temperature of 120 degrees C. for a period of three hours in a flask while a current of compressed air is passed through it. The air is previously dried by passing it through a tower filled with calcium chloride, then through two U tubes lacked with phosphorus pentoxide, and the moisture is removed from the oil and is collected in two small U tubes containing phosphorus pentoxide, protected from the atmosphere at the far end by a washing flask containing strong sulphuric acid. Electrotechn. Zeitung, volume, 46 pages 1447-8.

* * *

Cracking Heavy Oils at Ordinary Pressure.—Heavy oils are cracked at the ordinary pressures by the use of a metallic catalyst, which comprises metal turnings or borings. The oil is heated to a temperature of 550 to 600 degrees C. in tubes through which the vapors are circulated. From time to time the superheated vapor is passed through the tubes for the purpose of preventing the deposition of carbon.

Tests were made with an oil, possessing a specific gravity of 0.860 to 0.880 and the following results were obtained from 1000 kilograms of the oil. The yield of gas was 420 cubic meters, that of gasoline (boiling point 80 to 187 degrees C.) 275 liters and that of tar 184 liters. The gas contained from 40 to 45 per cent of non-saturated hydrocarbons, from 35 to 40 per cent of saturated hydrocarbons, from 10 to 15 per cent of hydrogen and from four to five per cent of benzene.

When the cracking is carried out at a temperature above 650 degrees C., then the yield of gas is raised to 500 cubic meters per ton of oil, and the gas is found to contain more hydrogen.

The illuminating power of the gas is approximately equal to that of acetylene and its thermal power is from 14,000 to 16,000 calories per cubic meter. When the gas is heated under pressure with a catalyst of the activated iron or nickel type it is converted into gasoline, possessing a boiling point between 30 and 170 degrees C., the yield being about 50 per cent. Les Matieres Grasses, 1926, page 7476.

* * *

Desulphurization of Petroleum Distillates by Silica Gel.—According to Brennstoffe Chemie, volume 6, pages 255 ff., different samples of silica gel were prepared by precipitating silicate of soda with the aid of hydrochloric acid or sulphuric acid, and then agitating the mixture with dry air at a temperature of 200 degrees C. or by agitating in a vacuum at a temperature of 300 degrees C. A sample of commercial sodium silicate was also employed in the experiments. All the samples of silica gel were found to be equally effective. A petroleum, coming from Borneo, was used in the experiments, this crude oil being free from sulphur. Certain definite quantities of organic sulphur compounds were added to this crude oil, and the latter was then agitated five times, each time with a fresh amount of silica gel. The duration of the agitation was eight hours. The reduction of sulphur obtained when the various sulphides or sulphur compounds were added to the petroleum is seen from the following table.

Ethyl sulphide $(C_2H_5)_2S$.....33%
Phenyl sulphydrate C_6H_5SH.....31%
Phenyl sulphocyanide C_6H_5CNS..88%
Phenyl isosulpho-vyanide C_6H_5NCS
. . ..17%
Ethyl sulphate $(C_2H_5)_2SO_4$.....100%

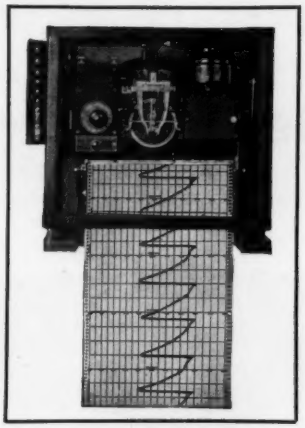
When various commercial petroleum distillates are treated with the silica gel, it was found that the sulphur content was reduced to the extent of 20 to 50 per cent, according to the nature of the oil.

* * *

Cracking Hydrocarbons.—High boiling petroleum oils, such as kerosene and gas oil, are forced through a heat exchanger situated at the upper end of a fractionating column, and a system of heating coils, into a horizontal, cylindrical cracking vessel, the oil in the coils and vessel being maintained at a temperature of 260 to 540 degfirees C. under a pressure of 100 to 1000 pounds per square inch. The liquid products from the cracking vessel, after passage through a system of pipes in the base of the fractionating column, are discharged under atmospheric or reduced pressure into a vaporizer, from which the vapors pass into the lower end of the fractionating column, the unvaporized residue being withdrawn from the system. Vapors escaping from the top of the fractionating column pass, together with gases generated in the cracking vessel, into a condenser, the condensed gasoline fraction being collected and uncondensed gases being burnt in furnaces for heating the coils. Liquid condensed in the fractionating column is returned to the process. An auxiliary cracking coil for treating oils, such as fuel oil, heavier than those treated in the main system, is attached directly to the vaporizer and may be operated at the same time as the main system, so as to blend the products from the two kinds of oil, or it may be shut off from the main system if desired. British Patent No. 240,339.

* * *

Action of Sulphuric Acid on Cracked Gasoline.—The behavior of gasoline in an engine depends on the proportion of paraffin, aromatic, naphthenic and unsaturated hydrocarbons present. To ascertain the strength of sulphuric acid most effective in polymerizing olefines, 100 cubic centimeters of gasoline were distilled, until the final boiling point and the amount of reflux into the flask on removing the flame being



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noted. Another sample was distilled up to the final boiling point of the original gasoline after treatment with acid. The difference between the volume remaining and the reflux in the first case was taken as a measure of the polymerization.

The cracked gasoline used was entirely soluble in 95 per cent acid. A portion was diluted with an entirely saturated gasoline, and the mixture had a final boiling point of 108 degrees C., while two per cent of the reflux collected. Its fraction up to 100 degrees was shaken for five minutes with 50 cubic centimeters of acid of 95, 92.5, 90, 87.5 and 85 per cent strength respectively. A drop in the reduction of volume between 95 and 92.5 per cent acid probably indicated the minimum strength for solution of aromatic hydrocarbons. A rise in high boiling point fractions occurred at about 91 per cent. J. Inst. Petorl. Tech., volume 11, pages 583-6.

Petroleum Refining Capacity Required in the United States

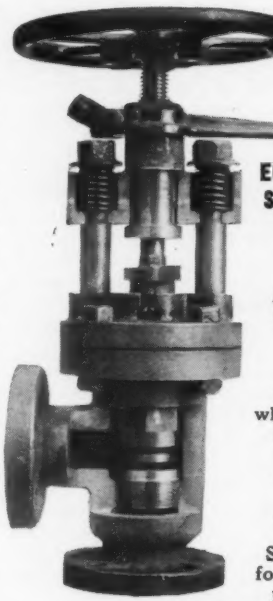
(Continued from page 68.)

as applied to 1930 using the motor fuel estimate of the Committee of Thirteen A. P. I., as a starting point. If the present estimates of highly competent and well informed statisticians in this industry are correct, the conditions indicated for 1930 may be met within the next year or two.

This table shows that it would require about 187 per cent of the skimming plant capacity in operation January 1, 1926, to meet the motor fuel demand. If all these plants were improved by the installation of full cracking capacity, their motor fuel output would just about equal the demand.

These figures, however, encounter the probable crude limitation. If only 735,000,000 barrels of new refinable crude are available as in 1925, the maximum amount available for skimming or added cracking is only 106,000,000 barrels. This would permit the operation of only 64 per cent of the skimming plant capacity operating January 1, 1926, whereas 187 per cent is required Such an amount of crude oil, if run for 60 per cent gasoline production, would permit operation of 68 per cent of the capacity of these skimming plants and leave a shortage of about 29,000,000 barrels of motor fuel per year. Any shortage of this kind will be met by increased cracking at the more complete refineries at the expense of the available supply of fresh gas and fuel oil, lubricating stocks and waxes. To do this, however, these refineries require the same added cracking capacity as is needed in the minor plants.

As stated above, such figures are in no ways accurate. They indicate strongly, however, the opportunity for refineries in the United States which are placed on an efficient basis. There



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Lower up-keep cost.

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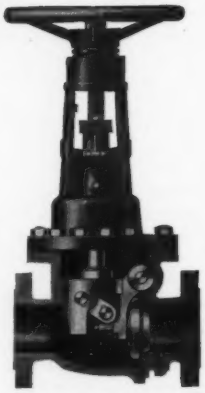

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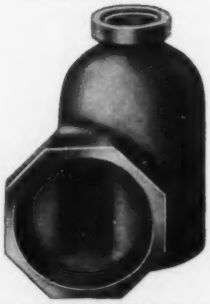

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Barco Lubricating Plug Valves.
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is no reason why the majority cannot be so placed so far as knowledge and available equipment are concerned. The entire crude capacity of the refineries included in Group B is absorbed in the output above indicated. If the skimming plants are not equipped to meets the demands, or if refineries included in Group B are not made and kept efficient, the necessary facilities will be added to the other refineries.

There is now needed skimming plant capacity of 396,000 barrels per day. If such plants could be improved by full cracking capacity, a crude capacity of 212,000 barrels per day is needed now. The available crude supply will apparently limit the usable future capacity to about 365,000 barrels per day with full cracking capacity. If so improved, there will be conserved a present investment of about $40,000,000 a large part of which if not made fully effective will be duplicated very soon and an early replacement of about $30,000,000 more, if existing plants are not brought up to date. Needless to say, it is not possible to save all of this investment because of lack of crude, faulty location, condition of plants or other controlling reasons. A large part of it can and should be saved and used as a basis for re-organization of existing properties. Such reorganization plans must include a definite arrangement for crude supply.

In connection with the gas and fuel oil supply and demand, there is a large element of uncertainty. If all the refineries of the United States were equipped for maximum gasoline production, there would be no fresh gas oil or fuel oil available from refinery operations. The tables show the supplies that might be available under different conditions. It is difficult to say how great the future need for such commodities may be. It will be largely affected by the price. The conditions vary greatly in different parts of the country. A large amount of the imported oil and a considerable portion of the domestic crude is not readily refinable with present methods, and in 1925 about 57,000,000 barrels of crude was burned as fuel. How soon any appreciable part of this heavy oil will be refined is now uncertain, but it is probable that ways will be developed as the need becomes urgent.

The market for special high grade commodities such as can be most advantageously produced by Pennsylvania refineries can and will be supplied by the most efficient concerns. The future of the Pennsylvania refineries can only be protected by their being placed and maintained on a basis of the highest efficiency and economy. There is ample indication of a growing demand for all of their refined products. As the shortage of motor fuel develops, the value of available cracking stock will increase. This will result in increased values for lubricants independent of any increase in the demand for such products.

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American (formerly Honeco) Controller AUTOMATICALLY controls temperature and pressure and relieves employees of this task. Gives them more time for other work and eliminates the uncertainty of hand control.

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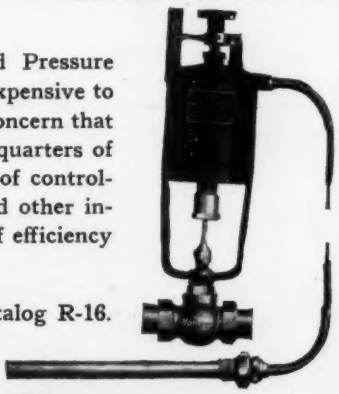

American Temperature and Pressure Controllers are simple and inexpensive to install. They are made by a concern that has specialized for over three-quarters of a century in the manufacture of controllers, thermometers, gauges and other instruments for the promotion of efficiency in the oil industry.

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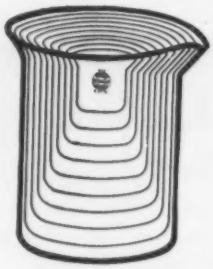

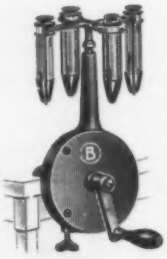

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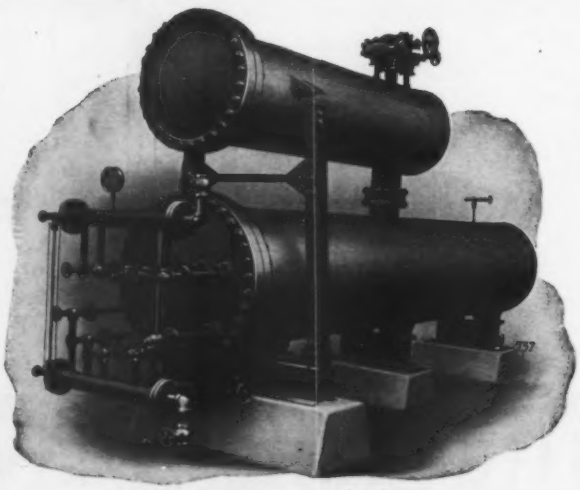

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REFINERY AND GASOLINE PLANT ACTIVITIES

J. M. Cameron Dies

Ardmore, Okla.—John Munro Cameron, president of the Cameron Refining Company of Ardmore, died March 29, in St. Louis of influenza. He established the Cameron Refining Company six years ago.

Another Seminole Plant

Tulsa, Okla.—Mid-Continent Petroleum Corporation will build a 6-unit natural gasoline plant in section 17-9-8, north of Wewoka in Seminole County. This will be the sixth plant of the county.

The Widdell Engineering Company and Arthur G. McKee & Company, Associates, have been awarded a contract by The Marland Refining Company, for improvements at their Ponca City refinery. This work will involve a three (3) Unit Gray Vapor Treating Plant, pipe lines and all accessories.

Wichita Falls, Texas.—The North American Car Company has purchased 134 tank cars from E. H. Eddleman, receiver for the Sunshine Consolidated Oil Company for a cash consideration of $132,325.

Offices Moved

Offices of the "Adsole" Company of America, subsidiary of a Japanese concern which is introducing the Adsole process to American manufactuers of natural gasoline, have been established in Suite 201 of the Los Angeles City Club Building, 833 S. Spring Street, Los Angeles, California.

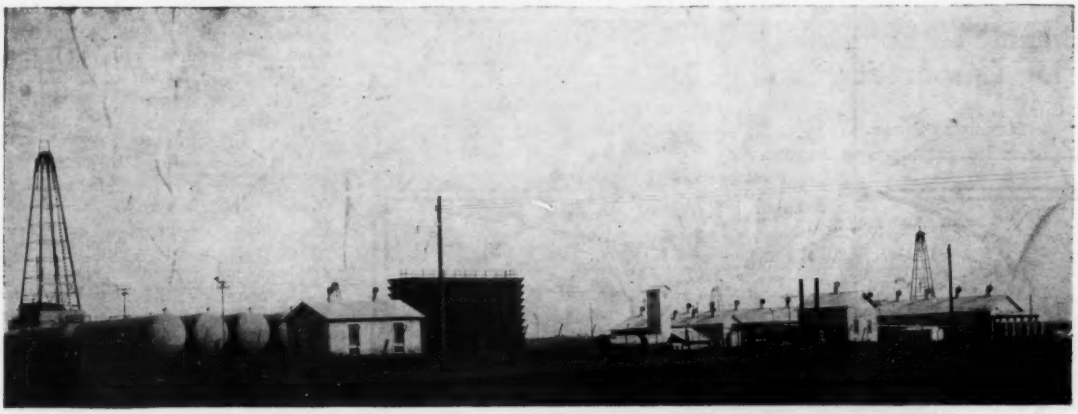
M. Hamada is in charge of the West Coast office.

Wichita Falls, Texas.—The Western Oil Corporation of Texas has purchased the 2500 barrel capacity skimming plant formerly operated by the Sunshine Consolidated Oil Company from E. H. Eddleman, receiver for the latter concern, for a cash consideration of $37,500. The new owners of the plant are having the six fire stills overhauled to begin operations in May on Wichita-Archer County crude. The plant is located near Wichita Falls on a 65-acre site, which was also included in the purchase price. Walter K. Campbell is president of the Western Oil Corporation, and headquarters are maintained at Wichita Falls.

Amerada Building

Ardmore, Okla. — The Amerada Petroleum Corporation is building a 10-unit natural gasoline plant in the Graham pool, Carter County. The exact location is the Palmer farm in section 31-2s-2w. The plant will use electric motors for much of its power. H. W. Harts is in charge of construction.

Chicago, Ill.—The Universal Oil Products Company, owners and licensors of the Dubbs Cracking Process, announce the recent sale of four Dubbs units to the Shell Company of California to be immediately constructed at the Martinez, California, refinery, which makes a total of nine Dubbs cracking units for this refinery. The Shell Company, in addition to these, has eight Dubbs units at its Wilmington refinery, four of which are already in operation. Further growth in the use of the Dubbs unit is seen in Producers and Refiners Corporation's ten units at the Parco, Wyoming, refinery, four at the West Tulsa refinery had two additional under construction in the West Tulsa refinery.



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RECENT REFINERY PATENTS

BY STAFF REPRESENTATIVE

No. 1,578,051, granted March 23 to Almer McDuffie McAfee, Port Arthur, Tex., assignor to Gulf Refining Co., Pittsburgh, for a process of improving oil by distillation with aluminum chloride, which comprises establishing and maintaining a flow of oil through a plurality of successively operated distilling means wherein it is distilled in the presence of aluminum chlorid and returning volatilized and condensed chlorid towards the first still in series.

No. 1,578,052, granted March 23 to Almer McDuffie AcAfee, Port Arthur, Tex., assignor to Gulf Refining Co., Pittburgh, for a method of making aluminum chloride from solid carbon and oxidized forms of aluminum with the aid of a flow of chlorin passing thereover, the process comprising shortening the period of induction in the production of aluminum chloride by first contacting with the solid materials a mixture of chlorin and gas containing an oxid of carbon and thereafter continuing the operation with gas containing an increased proportion of chlorin.

No. 1,578,053, granted March 23 to Almer McDuffie McAfee, Port Arthur, Tex., assignor to Gulf Refining Co., Pittsburgh, for a process of removing aluminum chloride residues from a vessel in which aluminum chloride has been used for catalytic treatment of petroleum hydrocarbons, and in which the residues are in the form of a caked mass, which comprises wetting such mass with water to disintegrate it into small particles and flushing such particles from the vessel in the presence of water.

No. 1,578,187, granted March 23 to Samuel A. Bullock, Port Washington, and Bertel T. Perry, Schenectady, N. Y., for an apparatus for forming an emulsion of oil and water for lubricating purposes, comprising an ejector, means to supply water under pressure to the nozzle thereof, a closed oil reservoir, a leveling trap, a pipe leading from the bottom of said reservoir to a point near the bottom of said trap, an air pipe leading from the top of said reservoir to a point near the bottom of said trap, the latter having an inlet for air in its top, a pipe leading from the bottom of said trap to said ejector and having a branch for the admission of air to regulate the flow of oil.

No. 1,578,201, granted March 23 to Thomas Midgley, Jr., Dayton, Ohio, assignors, by mesne assignments, to General Motors Corp., Detroit, for a fuel comprising an admixture of substantially 50 per cent commercial ethyl alcohol, and 50 per cent of a cracked gasoline, said cracked gasoline consisting of saturated hydrocarbons and unsaturated hydrocarbons, or "olefines" in the proportions of substantially 84 per cent and 16 per cent respectively.

No. 1,578,273, granted March 30 to Harry L. Edwards, Houston, Texas, assignor, by direct and mesne assignments, of one-half to G. H. L. Kent, Houston, Texas, and of one-sixth to Ray Richmond, Corsicana, Texas, for a treating apparatus for crude oil consisting, in a dehydrator for crude oil, of an approximately horizontal oil conducting pipe, heating sections therein, said sections being closed transversely except for oil tubes extending horizontally therethrough, a pipe for heating fluid connected to said sections, other sections between said heating sections being unobstructed to allow settling out of the water and having liquid outlets on the lower side thereof.

No. 1,578,802, granted March 30 to Edgar Milton Clark, New York, assignor to Standard Development Co., of Delaware, for a proces of digesting petroleum oils for the pyrogenesis thereof which consists in confining under pressure two separated bodies of relatively heavy oil within a digester, applying heat to one of said oil bodies, taking vapors from the latter over into the second body, abstracting heat from said last named body to cause condensation of the vapors of the desired products of pyrogenesis therein, and feeding the first named body the oil displaced by vapor condensation in the second body, continuing the said operation until said second named body becomes of substantially lower boiling point than said first named body, whereby a substantial conversion may be effected without distillation and at a relatively low pressure.

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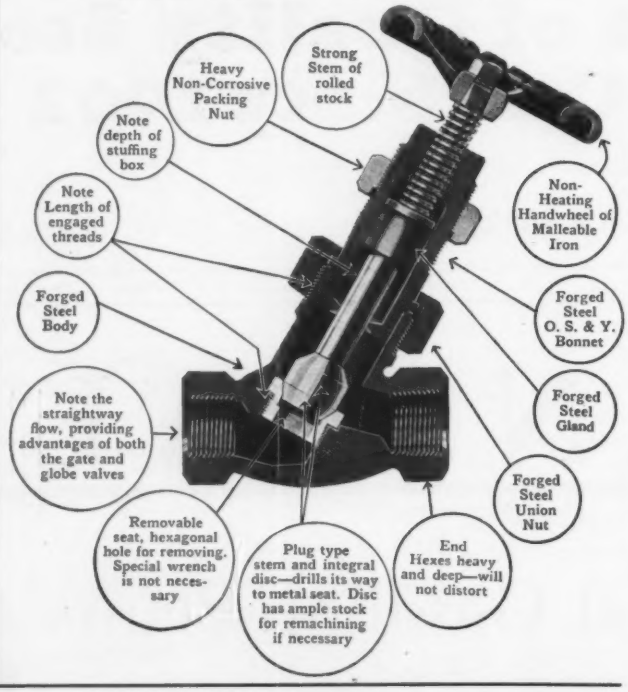
Heavy Non-Corrosive Packing Nut
Strong Stem of rolled stock
Note depth of stuffing box
Note Length of engaged threads
Non-Heating Handwheel of Malleable Iron
Forged Steel Body
Forged Steel O. S. & Y. Bonnet
Forged Steel Gland
Note the straightway flow, providing advantages of both the gate and globe valves
Forged Steel Union Nut
Removable seat, hexagonal hole for removing. Special wrench is not necessary
Plug type stem and integral disc—drills its way to metal seat. Disc has ample stock for remachining if necessary
End Hexes heavy and deep—will not distort

Sectional view of Globe Valve —Plug Type No. 682.

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WOODWARD, WIGHT & COMPANY, LTD.

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NEW ORLEANS, LA.

History of the Gas Engine

(Continued from page 31.)

far from that of a perfect gas. The mechanical action of a steam engine is very similar to the internal combustion engine. The comparison of the steam engine and the internal combustion engine mechanically are very similar in action but efficiency varies considerably. The theoretical answer is: The efficiency of the carnot cycle, the highest attainable is

$$\frac{T_1 - T_2}{T_1}$$

Where T_1 is the absolute temperature of the high point of the cycle and T_2 is the temperature of the low point, or in other words, the cycle works between the limits of T_1 and T_2. The value of T_2 is fixed by the atmospheric temperature and is the same for both internal combustion engine and steam engine. Assuming both of these engines to operate on the carnot cycle in the steam engine, the value of T_1 is about 862 degrees for 250 pounds steam pressure. With the value of T_2 at 70 degrees Fahrenheit, or 530 degrees absolute, the efficiency will be .385. With a temperature of 2500 degrees Fahrenheit in the cylinder of a gas engine, the efficiency would be .83 or more than twice that of a steam engine. Then the gas engine has the advantage of the steam engine in a ratio of .83 to .385, but theoretical considerations alter this materially under varying conditions and applications.

In the steam engine the maintenance of head in the steam from the point of origin to the engine cylinder, until after the expected energy has been exerted, is a most important factor to the efficiency of same. With the gas engine the reverse is true, and instead of retaining all of the heat in the cylinder, some of it must be removed by conduction, because temperatures are high enough to be injurious to the metals in contact with the hot gases. This excess head must be removed by means of jacket water. The effect of heat on the gasses in a gas engine cylinder is to increase the pressure in order to reduce T_2 as low as possible and thus increase the efficiency, the gases are expanded in the cylinder to bring the gases in the cylinder down to atmospheric temperature or expansion down to zero gauge pressure would be necessary. Practically, that is not possible and the gases are exhausted at a pressure and temperature considerably above the temperature of atmosphere. This constitutes about 25 per cent of the losses in a gas engine.

There are many different kinds of gas varying in heat value from about 100 B. T. U.'s to 2000 B. T. U.'s per cubic foot. Nearly all of the varying grades between these limits have been used as gas engine fuel. To make any definite remarks on any particular gas, the chemical constituents of same should be known and proportions in which they combine with the oxygen of air. Unless the compositions as above mentioned of the gas and the ratio of its dilution with air are known, it is impossible to ascertain temperatures and pressure, and to theoretically determine the exact value of the work it ought to do.

Proper Design and Operation Of Heat Exchangers

(Continued from page 46.)

surrounding the tube bundle. The two oils flowing on opposite side of the tube walls are referred to as the "fat" and "lean" oil. The fat oil has the higher gravity of the two.

Computations—The following results are to be computed from the experimental data taken:—

(1) Mean heating surface.

(2) Logarithmic mean temperature difference.

(3) Total heat transferred.

(4) Overall heat transfer coefficient.

(5) Mean velocity of lean oil.

(6) Mean velocity of fat oil.

(7) Mean temperature of lean oil.

(8) Mean temperature of fat oil.

(9) Viscosity of lean oil at the mean temperature.

(10) Viscosity of fat oil at the mean temperature.

(11) Density of lean oil at the mean temperature.

(12) Density of fat oil at the mean temperature.

(13) Kinematic viscosity of oil in tubes at the mean temperature.

(14) Determination of factor D_2.

(15) Determination of ratio D_1/D_2.

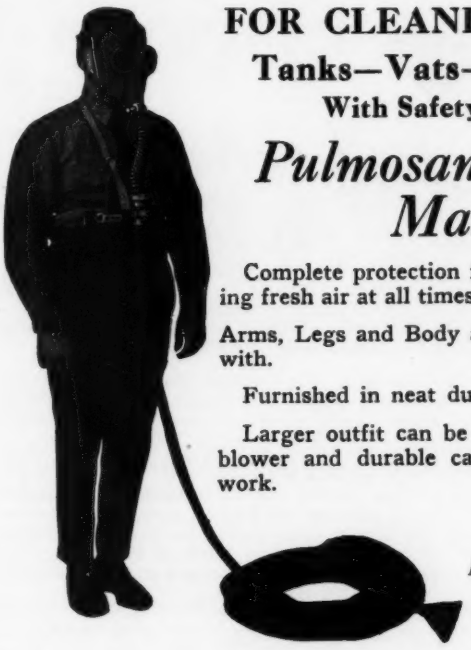
(16) Determination of factor $K\ D_1/D_2$.

(17) Determination of factor $D_1D_2V_1V_2d_1d_2/U_1U_2$.

(18) Determination of turbulence factor D_1V_a/Z.

(19) Type of flow corresponding to turbulence factor.

To Be Continued Next Issue



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Previously used on barge for storage of fuel oil. Prices $350.00 each, f. o. b. cars, Port Aransas, Texas, if purchased prior to June 1st, 1926.
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W. N. Matthews Corporation

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MATTHEWS MECHANICAL PAINTING EQUIPMENT

Natural Gasoline—A National Resource

(Continued from page 21.)

through the winter months in order to handle more easily the heavy summer demand. This storage stock often loses some of its gravity or volatility and natural gasoline is used to restore it to a commercial product. It is also blended by some gasoline plants with naphtha and with low gravity gasoline which when properly produced corresponds very closely to refined gasoline.

The natural gasoline industry is in its infancy and solicits and appreciates constructive criticism and suggestions from outside agencies. It has always followed the policy and showed its willingness to co-operate with any government bureau or any refineries in working out difficulties and problems as they arise. It combats and objects most strenuously to unfair, untrue and unreliable propaganda put out against it, intentionally or otherwise. In order to inform the public correctly regarding the natural gasoline industry and its product, disinterested and highly technical and scientific men are making an investigation, the results of which will be broadcasted throughout the land. If their findings are favorable, the burden of proof will naturally be thrown back upon those who have spread this misinformation. The only request the industry has to make of the general public is that it accept only facts substantially by proof and not the ideas of people who may be prompted by selfish motives.

Uniformity Needed

Cheap gasoline invites waste and waste must be discouraged as the oil industry is entitled to a fair price for its product. In return it should produce the best motor fuel possible. Since the price of low volatility gasoline which is offered especially in the summer months will undoubtedly be less than the price of higher volatility product, it should not be considered as a standard either in quality or price. The general demand for higher volatility in gasoline for year around use is rapidly growing in popularity and should continue to grow.

It is believed a more uniform price throughout the year would be possible by the use of higher volatility gasoline, which would materially assist in creating a more general and uniform demand for natural gasoline which so vitally affects this industry.

Natural gasoline plants are operated in practically every field in the country and aid greatly in increasing the production of crude oil. They hold a vacuum on oil producing sand, thereby increasing the production of petroleum; in other localities the residue gas from the plants is being put back into the sand under pressure which is enabling the producers to recover production unobtainable by ordinary methods.

No Curtailment

During depressions and dull seasons,

refiners are usually able to close down their plants or cut their runs to stills until the demand for their product strengthens sufficiently to justify full time operation. This is not true of natural gasoline plants as they must operate at full capacity continually, handling the gas as it is produced from the wells. In the past this has forced many operators of natural gasoline plants to run at a heavy loss and store their product because of market conditions. If a demand as nearly uniform as possible could be established it would not force this unjust loss on the plants and would make it impossible for other branches of the industry to stay out of the market until such time as they could buy natural gasoline below cost or at an unfair price to the natural gasoline manufacturers. We do not wish to put ourselves in the position of criticising the refining industry which is absorbing large quantities of our product at this time and which we expect will use even greater amounts in the future. They have many perplexing problems of their own to dispose of.

Does it not seem that the government and its agencies as well as the general public has a well-defined duty to perform? Can it further delay definite action in the conservation of petroleum and its products? The natural gasoline industry has full confidence that in the very near future this issue will be met squarely and that the proper results will be obtained.

Future generations must not be permitted to suffer a petroleum shortage due to our failure to use economically our natural petroleum resources.

In conclusion, let us again insist that the users of motor fuel follow their best personal interests by demanding a product containing a reasonable percentage of natural gasoline to insure volatility and by so doing play a part in the conservation of petroleum and its product and assist in maintaining a valuable industry.

George W. (Jack) Walton, for several years connected with the National Supply Company of Texas, with headquarters at Fort Worth, has resigned, effective April 1, to become associated with the Wilson-Snyder Manufacturing Company, of Braddock, Pa., manufacturers of oil field, pipe line, and refinery pumps. Walton, whose new headquarters will be in Dallas, is to be in charge of the Wilson-Snyder Company's sales activities in the Southwestern (Mid-Continent) territory.

Offices Moved

Los Angeles, Calif.—Due to the necessity of expanding office facilities, headquarters of the National Gas Products Corporation, Los Angeles, California, have been moved from 621 Detwiler Building to 1216 Detwiler Building.

REFINERY EQUIPMENT!

Storage Tanks
Complete Refineries
Agitators
Loading Racks
Stills
Gate House Equipment
Fore Coolers
Condensor Boxes
Heavy Pipe Clamps

7 Plants

Expansion Joints
Pipe Line Supplies
Acid Tanks
Flanges of all kinds and descriptions
Derrick Forges
Tail House Lock Boxes and equipment

7 Plants

Complete Refinery United-Built

Inquiries for Oil Well and Refinery Equipment earnestly solicited and quotations will be promptly furnished without obligation.

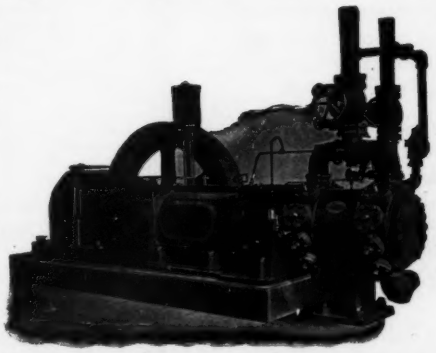
United Iron Works, Inc.

Tulsa Kansas City Dallas

Vilter

Ammonia Compressors Fittings and Pipe Coils

Render Years of Reliable Service



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62 Oil and Refining Companies now using the

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For All Purposes, Kinds of Gas, Pressures

Write for Latest Condensed Catalog

Lee B. Mettler Co.

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WHY THE TRADE-MARK

A Trade-Mark is the symbol showing the origin or source of the article to which it is affixed. It is also a guarantee to the purchaser of the manufacturing skill of the owner, the quality of the goods and the correctness of the weight and size of the article.

The Garlock Trade-Mark, which appears either on the package containing the packing or the commodity itself, is not only emblematic of all the above stipulations but immediately signifies the product is "Quality Controlled."

All Garlock Trade-Marked Packings are manufactured complete from the crude to the finished product in our own factories. They are built for economical Mechanical Packing Service by skilled craftsmen.

The caliper and rule enclosing the Diamond and the word GARLOCK are registered Trade-Marks of the Garlock Packing Company. Each is known as "The Emblem of Quality and the Insignia of Service." They are the distinguishing marks of first class merchandise honestly manufactured.

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Manufacturers of GARLOCK PACKINGS

PALMYRA, N.Y.

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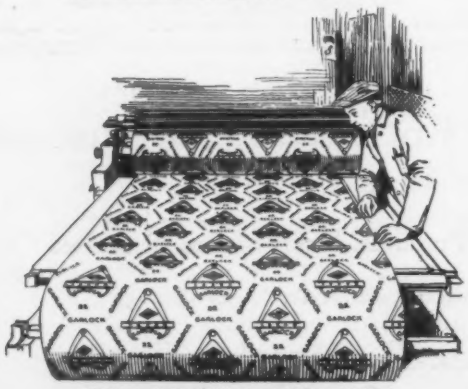

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The Standard Packing of the World

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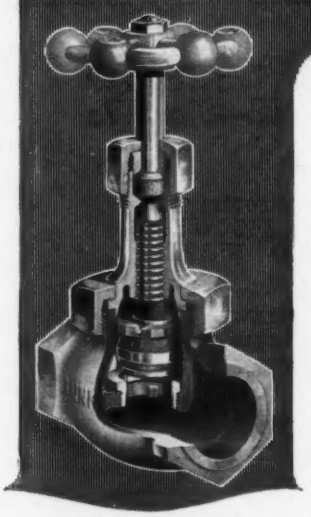
Minimum Maintenance Expense Insures Maximum Economy

"Economy" is the watchword of industry these days, and anything which makes it possible to reduce costs is of vital interest to the men responsible for maintaining production schedules.

In the power plant, discriminating users are no longer buying just valves; they are buying a definite valve service—continuous satisfactory performance over long periods of time, freedom from frequent costly repairs and replacements, and convenient sources of supply to insure prompt deliveries.

LUNKENHEIMER "FERRENEWO" AND "RENEWO" VALVES



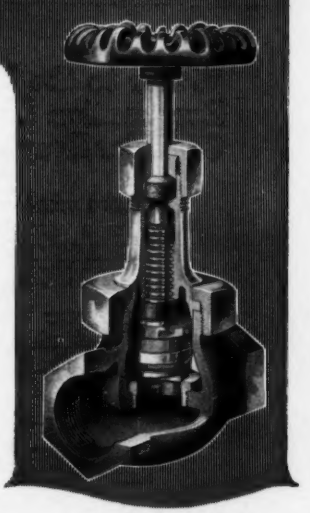
Iron Body "Ferrenewo"
150 lb. W. S. P.
Union Bonnet Type ¼ to 2 in.
Outside Screw and Yoke Type
2½, 3 and 4 in.

embody all the necessary factors to meet the requirements of the most critical purchaser of equipment.

The Iron Body "Ferrenewo" for the lower pressures, and the Bronze "Renewo" for the higher pressures provide an ideal combination upon which an ever increasing number of plants are advantageously standardizing.

They are of the same design, with regrindable seating surfaces. When worn beyond repair the nickel seats and discs can easily be renewed. All other parts of the valves are likewise renewable. Seat faces can be reground and parts renewed without removing the valves from pipe lines.

In sizes ¼" to 2" inclusive, union bonnet types, all parts of the "Ferrenewo" and medium "Renewo" are interchangeable, with the exception of the bodies and bonnet rings. This feature makes it unnecessary to carry a wide assortment of replacement parts, reduces stock-room investment and simplifies ordering and handling.



Bronze "Renewo"
Medium, 200 lb. W. S. P.
Extra Heavy, 300 lb. W. S. P.
Union Bonnet Type ¼ to 3 in.
Outside Screw and Yoke Type
1½, 2, 2½ and 3 in.

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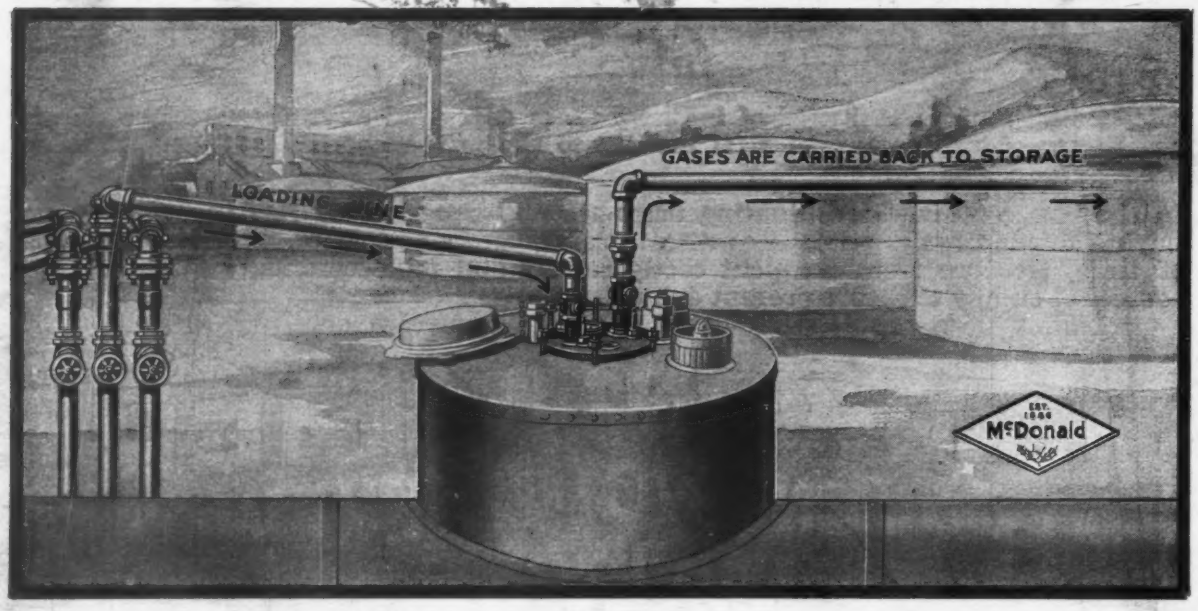
By Loading W[illegible]Univers[illegible]Gastite Dome Covers



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Hot weather—and lots of it—is almost here. Protect yourself against these tremendous evaporation losses by using Universal Gastite Dome Covers. Ask for literature and quotations.

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